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THE MULTIPLICITY OF PUBLIC TENDERS.

ONE need hardly attempt to demonstrate that the whole subject of public tendering has reached a most serious condition, and it is a fact quite obvious to most electrical engineers that the evil becomes more aggravated in every new contract.

The demand for electrical machinery seems to be sufficient to induce an increasing number of contractors and manufacturers to enter the market, with the consequence that the number of tenders submitted for public contracts is rapidly growing.

On the general question of an increasing and more strenuous competition we have nothing whatever to say; this will eventually settle itself; but we consider that there is one element in the present method of tendering against which manufacturers have a legitimate cause for complaint, and in making a protest, we do so with the full consciousness that the majority, if not all contractors, and at the same time a good many consulting engineers, will recognise the justice of our remarks. The point to which we particularly wish to address ourselves is the extraordinary amount of duplication and repetition which occurs in almost every instance of public tendering. For, as we shall show, it is not the number of firms who submit tenders, but the pernicious system of duplication which is responsible for the present deplorable condition to which public tendering has been reduced. It is not surprising that this system of duplication should have been adopted, because many specifications are drawn up in such a way as to permit the submission of alternative tenders; but these alternative tenders are not due so much to variations in the design of generators as to the fact that several types of engines are included by each contractor. While we recognise that a fairly open specification has its advantages, we venture to suggest that duplication is wholly unnecessary, and, in the interest of the electrical industry, it is highly desirable that some method should be devised by which the great waste of time and labour on mere repetition work is prevented. A contractor does not hesitate to spend time and money on the preparation of estimates and drawings on the mere chance of obtaining a contract, but it is hardly fair that he should be asked for an unnecessary variety of prices when he is merely repeating the operation of every other contractor.

In order to realise the lengths to which we are drifting, one may be permitted to refer to some recent cases, which serve to demonstrate the inutility of the present system. Some time ago the Corporation of Worcester advertised for generating plant, and for this 62 distinct and different prices were submitted by contractors. These prices were sent by 29 different firms, yet the total number of types of engines amongst the whole of the tenders was eight, and upon these the changes were rung sufficiently to bring the number of quotations up to 62. In this case tenders were

furnished only by makers of dynamos, but it is now becoming an accepted practice for engine builders to send in prices for combined sets, and this is serving to make confusion worse confounded, because, in addition to the cross-tendering which arises when many dynamo makers quote for different types of engines, we now have engine builders, submitting several types of dynamos, which have been already tendered for direct by the makers.

But there are many worse cases than Worcester, and to two of these we feel justified in alluding. Three large sets were required by a municipality, and for this contract there were not more than 24 different types of dynamos submitted, and 12 or 14 distinct types of engines; yet, so considerable was the repetition and cross-tendering, that the total number of prices which the consulting engineer had to consider was actually 240. A similar state of things occurred in another town where the total amount of electrical plant required represented about £900, yet this was sufficient to induce 50 firms to submit more than 200 prices, and it is probable that not more than six different types of engines were submitted. This is rapidly reducing the practice of tendering to an absurdity, and it is with a view to obtaining some improvement that we ventilate the subject.

It is not suggested for a moment that consulting engineers do not carefully consider the tenders which they receive; but it must be remembered that engineers can only give a certain portion of their time to any particular scheme, and it is not unnatural to assume that 20 tenders will receive ore careful consideration than 200.

In order to prevent this wholly unnecessary repetition and cross-tendering, it ought to be possible to provide a remedy, and we would submit one that is worth some consideration —one, moreover, which we strongly advocated in these columns almost exactly a year ago.

It has become an established custom to combine engines and dynamos in one contract, which means that the electrical contractor, whose section of the work is usually the least, takes the direct responsibility of both engine and generator. We do not suppose that manufacturers raise any specific complaint against this arrangement, although it is sometimes inconvenient to the contractor, and is occasionally troublesome to the consulting engineer. But is there any reason whatever why generating plant should not be divided into two distinct tenders, one for engines, the other for dynamos, thus making each contractor responsible for his portion of the work, and giving the consulting engineer direct control over each? If this plan were adopted, it would not only give greater convenience during the fulfilment of a contract to everybody concerned, but what is of paramount importance, it would absolutely prevent the duplication and repetition of tendering which at present prevails. In short, such an arrangement would mean that the consulting engineer, instead of receiving 250 prices, would in all probability never receive more than 30; moreover, he would be dealing direct with the engine builder, and might possibly obtain an engine cheaper than he does at present, and thus save the margin of profit which dynamo builders occasionally add to the cost of the engine to compensate them for the trouble of the joint contract. There might be some slight inconvenience in this plan, but we feel sure that it would be in no way comparable with the waste of time and labour arising from the wholly irrational and unnecessary methods which now exist.

The Shoreditch Combination.

THE accounts of the Shoreditch electricity and refuse destructor undertaking for the year ended March 31st 1901, will prove an unpleasant surprise to the advocates of such combinations in general, and in particular to those who are specially interested in this metropolitan enterprise. It has for several months been stated that the past financial year would show a loss of two or three thousand pounds, and the abstract of accounts which have just been issued exhibits an actual deficit of £3,266. If this is the manner in which the electric light is obtained from the dustbin, the sooner the dustbin is dispensed with the better, especially if repetitions of the present position are expected in future years; but possibly there are special reasons which have contributed towards bringing about the unfortunate results disclosed by the accounts, and which may not be likely to recur on any subsequent occasion. However that may be, it might be thought, in view of the disastrous failure of the past year, that the Lighting Committee would have presented a report giving a brief explanation of the causes which have led to the creation of this situation of affairs, but for reasons best known to the members, the committee has carefully refrained from doing anything of the kind. In announcing the publication of this accounts, the committee merely recommends "that the same be received, and the deficiency of £3,265 16s. 7d. shown by the accounts be carried forward." It is therefore necessary to turn to the figures themselves—they appear on another page of this issue—in order to ascertain why gold has been found at the Borough Council's bankers instead of being discovered in the dustbin.

Underground Railways.

FOLLOWING up our comments of last week upon the place of the shallow tunnel electric railway in the future rapid transit of London, we are able to give in another column of this issue some notes on the character of the tunnelling operations which have been proceeding in New York for the past 18 months or so. It is a curious coincidence that just as our L.C.C. electric traction officials have returned from the States after inspecting the shallow tunnel works, the leading spirits in the New York Rapid Transit line should deem it necessary to come over here to investigate the operation of London deep level electric lines. As Mr. W. B. Parsons says, however, the conditions underground in New York are very different from those obtaining in London. One of the main advantages secured by the adoption of the shallow tunnel is the avoidance of lifts. We all know what an expensive item these have been to the City and South London Railway from the very first, and it is in dispensing with such luxuries that the Metropolitan and District lines will find one of their chief weapons for competing with the Central London when their electrical conversion comes to pass. The Hon. Lyttleton resumes his arbitration sittings on Tuesday next, 29th inst., and we hope for the benefit of all concerned that two or three days' serious work will suffice to settle this troublesome matter once and for all, and more or less amicably. The need for improved travelling facilities, whether by shallow or deep level lines, or by conduit or trolley tramways, is far too pressing to be played with any longer.

"Stand-by" Supply.

WHEN the draughtsman of the Electric Lighting Act and the model form of order inserted the clause which puts an obligation upon undertakers to "give and continue to give" a supply to all owners or occupiers in streets scheduled for supply, a hardship was created which is only now bearing its natural fruit. The only corrective is the ridiculously small possible minimum that may be required from all applicants for

supply, say, some 13s. or 14s. per quarter, which, with meter rent, tots up to less than £1, or let us put it at less than £4 per annum. Considering the incidence of standing charges, it is a matter requiring no exhaustive proof that in electricity supply the revenue should be required to bear some definite proportion to the capital involved before an onus falls upon the undertakers to accept an application. This is recognised in principle by the power given in orders to call for a guarantee for two or three years of a revenue amounting to 20 per cent. upon the cost of new mains before the undertakers can be compelled to provide the same. What is lacking in the General Acts has, in the case of Bury, been provided by a clause in the local Municipal Tramways Act, which provides that a person shall not be entitled to demand a supply for stand-by purposes unless a minimum annual sum be guaranteed to give a reasonable return on the capital expenditure, and standing charges, incurred to enable the maximum demand of such person to be met. This clause should be embodied in the next General Act passed. Although, as in the case of Glasgow, where powers to inspect, &c., wiring, were obtained by a clause in a local special Act, it is possible to drive a coach and four through general Acts by local special Acts in whose omnibus provisions sections are inserted limiting the responsibilities of the undertakers in this way, it is not a satisfactory procedure, having regard to the widespread influence of the electrical industry. One cannot help sympathising with station managers, and as they have a good case, the principle should be made universal and not local.

Borough Electrical Engineers as Consultants.

Considering the mass of routine that municipal engineers are called upon to get through owing to committee and council agendas, reports, estimates and sundry other calls upon their time, it would seem as if they could ill-afford to devote much of a working week to general consulting practice. The action of the Croydon Corporation in discussing in open meeting the propriety of their chief electrical officer will come as a reminder to many that while Electricity Committees may be lenient, and even pass resolutions permitting considerable licence to their officials, the public, when they come to learn of such arrangements, may not always view them in the same light. As public officers are, after all, dependent for their reputation and advancement upon the goodwill of the body whom they serve, and, therefore, upon that somewhat indefinite, but very real, thing called public opinion, it behoves them to be particularly prudent and circumspect in all their dealings. Assuming that a fair salary be paid, and that the business is of moderate size, it must be evident that only a man of genius can afford to have many irons in the fire at once. Should anything go wrong, the captious critic is only too liable, with or without justification, to ask whether the official would not be better employed in the public interest by devoting the whole of his time to the duties of his office, than in utilising a portion—which can hardly be specified—in adding feathers to his own nest, when that nest is maintained by the permanent position he probably ably fills. We are quite aware of the arguments *per contra*, but these are beside the question. As "Cæsar's wife must be above suspicion," so the professional man when he elects to grace a public position must not only be above suspicion, but he must take care not to be suspected, and he can only do this by setting his face against many things that are in themselves harmless, but which in the exigencies of politics, or in the days of annoying technical ill-luck, may be bandied about to his detriment. On the lowest grounds of self-interest "it does not pay," and those who glance over the cuttings from the provincial press from week to week, and have the burden of sifting tit-bits from the records of proceedings of Town Councils, know this very well.

The Mercadier Telegraph.

In a note addressed to the Académie des Sciences, M. Mercadier describes some of the latest results he has obtained in experiments in simultaneous signalling with his telegraph system. It will be remembered that in the notice of this system which appeared in the Electrical Review for August 9th, it was stated that it was possible to utilise the circuit simultaneously for the inventor's multiplex system and for ordinary telegraphing by means of Morse or Hughes apparatus. This arose from the fact that the currents employed in the Mercadier system were undulatory currents syntonised by means of a series of electric tuning forks. In July last trials were made with the multiplex system between Paris and Bordeaux. Using the arrangement of Cailho, it was found possible to receive and forward messeges for hours by the Mercadier system, employing as many as 12 different electro tuning-forks, and at the same time, without the operators being able to detect it, to employ on the same circuit either a Morse apparatus, a Hughes apparatus, or even a Baudot apparatus with four keyboards, for the transmission by continuous currents of a distinct set of signals and telegrams. The same results were also obtained with an intermediate station established in the same circuit at Tours. No modification of either the multiplex or ordinary apparatus was necessitated, nor was the least difficulty experienced. The inventor claims that these results are of high scientific value, inasmuch as they demonstrate the possibility of crossing without disturbance as many as 24 electric movements in a point of a metallic circuit, a remarkable confirmation of the mechanical law of small movements. Also it is claimed that the experiments prove the possibility of transmitting by a single circuit between two stations separated by 700 to 800 kilometres of distance, over 1,300 telegrams of 20 words each in one hour, 900 of which can go in either direction. To demonstrate the rapidity of this combination of systems, the author instances a newspaper page of about 9,000 words which could be transmitted from Paris to Bordeaux by the multiplex alone in one hour; by the multiplex and Baudot with four keyboards working simultaneously in a half-hour only, and during this half-hour the remote station could send to Paris, with the same apparatus, matter equivalent to a half page of the newspaper.

The Fire at the Sydney Power House.

Our Sydney correspondent, writing under date September 17th, gives the following account of the unfortunate fire which occurred on Thursday evening, September 12th, at the Ultimo power house of the Sydney electric tramway service, resulting in a complete stoppage of all traffic for about 21 hours:—"The fire occurred in the cable tunnel which carries all the feeder cables, and is supposed to have been caused either by a short-circuit or the overheating of a resistance placed there temporarily. The insulation of the cables was fired, and rapidly increased owing to the draught from the tunnel, and passed up the back of the switchboard, and flared sufficiently high to set light to the wooden lining of the roof. All the feeders had the insulation burnt off, but owing to the fact that the precaution was taken of covering up engines and dynamos with tarpaulins before the fire brigades appeared, no damage was done to the generating machinery. Three panels of the switchboard were badly cracked, and many of the measuring instruments damaged by fire and water. Traffic was resumed on Friday at about six o'clock, but on Saturday morning, while repairs were being effected, a short-circuit occurred, and one of the magnetic cut-outs failing to act, some damage was done to the switchboard, and traffic was again interrupted for about an hour and a half. During the main interruption to traffic the Mosman and Willoughby services were kept running with a partial service by means of the old plant at the Ridge Street power house, which fortunately had not been dismantled, and the Rose Bay service was maintained by the plant at the Rushcutter Bay power house." The Sydney tramway system and the Ultimo power house were described in the Electrical Review for November 9th and 16th, 1900.

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THE JAMES WATT LABORATORY, GLASGOW UNIVERSITY.

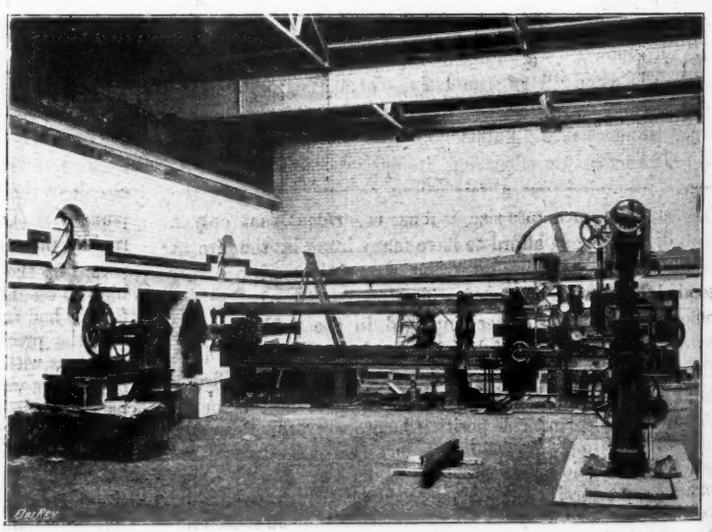
The new engineering laboratory which has been added to the Glasgow University is appropriately named the "James Watt Laboratory," and was, with equal aptness, formally opened by Lord Kelvin, Honorary President of the International Engineering Congress, while the Congress was in session. The laboratory will go far towards supplying what has been, perhaps, the greatest want of the University. While the engineering classes under Prof. Barr are probably the largest of the kind in the kingdom, the apparatus and equipment provided up to the present for carrying out experimental work have been of the most meagre description. All this will be changed by the inauguration of the new laboratory, which is equipped with the most modern testing machinery, and is also to contain experimental steam and gas plant, and electrical apparatus.

"James Watt" Laboratory, Glasgow University.

The building, as shown in our illustration, has been designed on the style of the main University buildings, and is, therefore, both pleasing in itself and in harmony with its beautiful surroundings. We have only one regret—that the view of the University from the Gilmore Hill entrance is practically spoilt by the intervention of the new buildings.

An overhead traveller is provided in the test room for handling heavy weights.

At present the principal machine installed in the laboratory is a 100-ton universal testing machine, of which we give a view; this is worked by a hydraulic ram, supplied with water from an accumulator. The speed of straining can be varied from 100 in. to 0·1 in. per minute during a test. The machine is fitted with an autographic recorder for drawing stress-strain diagrams; arrangements are made for carrying out tension, compression, torsion, and shearing tests, and for verifying the accuracy of the measurements. The most modern improvements have been introduced into the design of the machine, several of which were due to Prof. Barr. The machine was built by Mr. J. H. Wicksteed, of Leeds, and if, as no doubt will be the case, the whole of the equipment is made to the same standard of perfection, the James Watt Laboratories will eventually be second to none in the world.



100-Ton Universal Testing Machine.

THE COOPER-HEWITT VAPOUR LAMP.

A few months ago we gave a description, according to the information then available, of the vapour lamp invented by Mr. P. Cooper-Hewitt, and exhibited by him at the Conversazione of the American Institute of Electrical Engineers last spring. Shortly after that meeting, the inventor gave some information regarding his lamp in an article which he contributed to the *Electrical World* of New York, but many of the details were not then disclosed, on account of pending patents. These patents have only recently been granted, a series of 10 patents being issued to Mr. Cooper-Hewitt in the third week of September last. Curiously enough, most of the information which they provide is contained in the one patent which the inventor has taken out in this country, and which has been open to all since the beginning of the present year. Comparison of the dates of the different documents is interesting. Seven of the American patents were applied for on April 5th, 1900, and are only issued now after an interval of over 17 months; the remaining three, which are subsidiary patents, were applied for on January 25th, 1901, and have been issued along with the earlier set. The English patent, on the other hand, which contains practically all that is contained in the American patents, was applied for in the last week of June, 1900, and sealed near the end of December, 1900.

In our earlier article we dealt at some length with the contents of the British patent, so that at the present time we need only dwell upon the new or fuller information given in the later documents. The American specifications are not yet in our Patent Office Library, although the *Journal* of the American Patent Office, containing the names and numbers of Mr. Cooper-Hewitt's patents and the words of his claims, can there be seen; but in the *Electrical World* of New York for September 28th there is an article dealing

with the new patents, much of which is evidently very close to the actual text of these documents. By comparing this article with the British specification, we can discriminate between new and old information.

The inventor's aim, it will be remembered, is to produce an electric lamp, in which as little as possible of the energy shall be dissipated in heat—as much as possible shall be used in giving light. For this purpose he finds that incandescent gases or vapours afford the best means, and his lamps consist of glass tubes, fitted with electrodes and filled with rarefied gases or vapours which are kept incandescent by the passage of a current through them under moderate electromotive force. The inventor points out that these lamps do not act upon the arc principle, but that the vapour acts as a conductor for the current, and the special feature of his invention is, that he claims to be able to control the resistance of the vapour path, so as to suit the pre-determined E.M.F. for a particular lamp, with even greater accuracy than can be done in the case of a carbon filament. For each conducting gas or vapour there is a particular density for which its resistance to the passage of a current is a minimum, so that, starting from that point, the resistance increases if the density be either increased or diminished. The total density is a function of the pressure (as determined by the dimensions of the containing vessel) divided by the temperature.

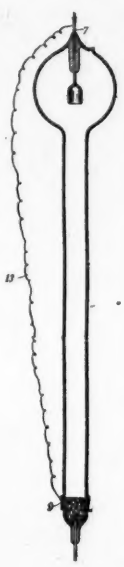


Fig. 1.

Take, then, such a lamp as that represented in fig. 1, which shows one type of Mr. Cooper-Hewitt's lamp. When the lamp is at work, the highest temperature at any cross-section perpendicular to the length of the tube is found at the centre, and there will be a fall of temperature along the radius to the circumference where radiation of heat takes place. The density, therefore, is smallest at the centre, and increases along the radius to the circumference. If, then, the density of the vapour when no current is passing is at, or below, that of minimum resistance, the zone next the circumference will, when current is allowed to pass, most nearly approach to the state of maximum conductivity (or minimum resistance), and there will be a gradual increase of resistance along the radius from circumference to centre. On the other hand, if the density of the vapour when no current is passing be greater than that of minimum resistance, then, when current is allowed to pass, the zone of minimum resistance will be an annulus of radius less than that of the tube; inside this zone towards the centre, and outside it toward the circumference, the resistance will increase, while the density decreases inside the zone but increases outside it.

It is not advisable to have the zone of maximum conductivity next the circumference, as injury may thereby be done to the glass vessel by the current; but if the density of the vapour, before current passes, is at, or below, that of maximum conductivity, a radius can be chosen for the tube sufficient to cause the vapour accumulated at the circumference, in consequence of the heat generated by the passage of the current, to have a density greater than that of minimum resistance, and then the condition of affairs is that explained in the second alternative above. The best available working conditions are obtained by having the initial density above the state of minimum resistance.

The control of the resistance depends on the resultant temperature of the gas, due to the heat developed by the current and that radiated by the tube, so that the aim is to maintain definite this temperature at predetermined pressure.

In lamps—such as that of fig. 1, with a mercury electrode—where vapour is produced by volatilisation of the liquid in the tube, the density may increase with increase of temperature, and for successful working such a lamp should be so constructed that, when the density of the vapour has reached the most suitable value for practical operation, the rate of emission of heat from the lamp should equal that of development of heat by the passage of the current. The bulbs on the tubes of some of the lamps, as in fig. 1, are introduced to provide a suitable radiating capacity for the accurate working of the lamp. These recesses are always placed out of the conducting path of the vapour. With permanent gases as the conducting medium, these radiating chambers are usually unnecessary, as the proper density is obtained when the lamp is constructed, and the temperature controls, and is in turn controlled by the current passing.

The inventor does not advance any precise theory of the working of his lamp, but he suggests that it may be explained thus:—If the E.M.F. at the terminals of the lamp increases, the greater current flowing tends to develop a higher temperature, which, in turn, diminishes the density, and thereby increases the resistance, so that a balance can be effected, thus making the lamp self-regulating. But it must be remembered that this theory rests upon the hypothesis that the resistance to current at the junction between electrode and gas is *small* relative to that of the gas path itself; and as we have shown in our earlier article, this would appear to be in direct opposition to the best known investigations on the properties of rarefied gases. For the present, however, we may confine ourselves to the description of the lamp.

Special arrangements have to be made to enable the lamp to act promptly when current is switched on. Gases of themselves offer great resistance initially to the passage of a current, but the inventor has found that by adding small quantities of certain materials to the lamp, it becomes possible to start a current under a moderate increase of electric pressure. The best substance he has found for this purpose is sulphide of mercury, a very small quantity being added to the lamp along with the mercury, when mercury is used to produce the vapour. The subsequent process of manufacture of the lamps is described at some length in the specifications.

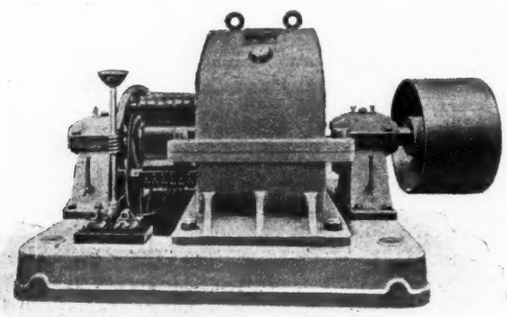
At starting, the terminals of the lamp are connected to the supply mains of proper voltage, but in addition there is placed in the circuit leading to the lamp the secondary coil of a transformer, whose primary is connected to the supply circuit through a form of Wehnelt interrupter. By this means a current under high pressure is made to pass through the gas, which then affords a path for the current under low E.M.F., and as soon as this has been brought about, the high potential current is automatically cut out. It has further been found advantageous, if the lamp is to be started without external heating, to surround the tube in the neighbourhood of one of the electrodes (or both, in an alternate-current lamp), by a band of conducting material, such as tinfoil, which is then connected with the other electrode, or led to earth. See fig. 1, where the band "9" outside the tube is connected to the electrode "7" by the connection "13." With this arrangement a lamp which would otherwise require currents of very high potential to start it, may be started without difficulty. The band should project a little beyond the electrode which it surrounds. Since the potential of the main current is applied to the lamp during the time that the higher potential starting current is acting, it is desirable, if an intermittent current as distinguished from an alternate current is used and a continuous current is to be employed in the lamp, that the E.M.Fs. should be in the same direction.

The author's descriptions deal almost entirely with mer-

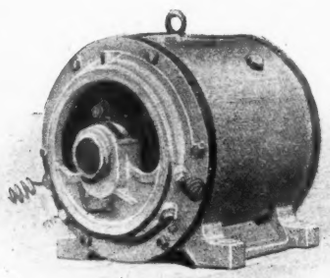
cury vapour lamps, but he does not limit himself to the use of this substance. Nitrogen, for example, may be used. We have referred formerly to the question of the colour of the light of a mercury lamp, owing to the lack of red rays; but it would appear that the inventor has succeeded in remedying this, for we are told that "nitrogen and other gases develop red rays in abundance, and when combined with the mercury rays a beautiful result is obtained." No particulars, however, are given.

We have dealt formerly with the dimensions of the lamps, but we may give here those of a specimen lamp embodying in practical form the principles we have been considering. The lamp is made of glass, having a bore of $\frac{3}{4}$ in. in diameter; the length between the electrodes is 54 in., and the chamber lying outside the path of the current has a radiating surface equal to a spherical area 3 in. in diameter. With a positive electrode of pure iron and a negative electrode of liquid mercury, this lamp will run under a pressure of about 120 volts, and will pass approximately 4 amperes of current when the surrounding temperature is that of an ordinary room—about 75° F.

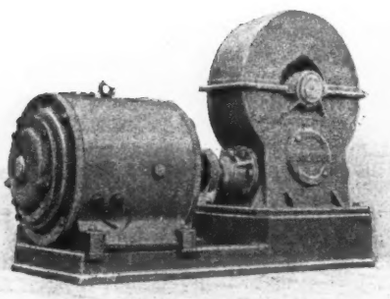
We may add, in conclusion, that Mr. Cooper-Hewitt's American patents begin with No. 682,691, and go on with consecutive numbers.



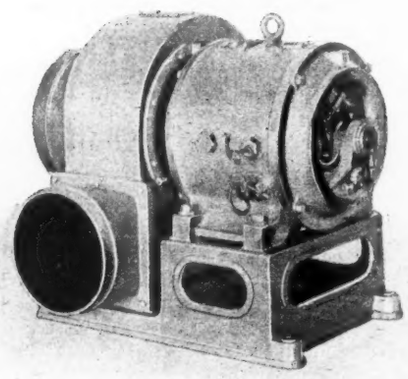
50-kw. Fynn Dynamo.



Semi-Enclosed Motor.



Gas-tight Motor with Worm Gear.



Motor Coupled to "Sirocco" Fan.

GLASGOW INTERNATIONAL EXHIBITION, 1901.

XIV.

Messrs. Rosling, Appleby & Fynn, Limited.

An interesting and representative exhibit has been arranged by Messrs. Rosling, Appleby & Fynn, consisting chiefly of dynamos and motors. The largest of these is a 50-kw. dynamo, giving 440 amperes at 110—115 volts, 540 revolutions per minute. The dynamo is of the open type, with four poles. The steel pole core and shoe is in one piece, bolted to the cast-iron yoke with a single bolt, and secured in the correct position by a steady pin. The field magnets are compound-wound. The armature is of the slotted core, drum type, with bar winding; this requires no support under the ends, but is tightly bound in place. Special ventilating ducts are provided to ensure small temperature rise, and the machine can carry a large overload for some hours without overheating or sparking. Carbon brushes are used, copper-plated and sweated to copper straps, and pressed on the commutator by springs.

The above dynamo is driven with a Hendry laminated belt by a 17-h.p. shunt-wound motor of similar design, running at 950 revolutions per minute on 220 volts. The motor armature is wire wound on Mr. V. A. Fynn's system, which gives an extremely neat appearance. A semi-enclosed motor of 13·5 b.h.p. is shown, taking 51 amperes at 220 volts, 950 revolutions per minute. The end plates are, for convenience, divided in the horizontal plane, but the bearing is solid with the lower half.

A completely enclosed motor of 23·5 b.h.p. forms another exhibit. The frame of this machine is cast in one piece, with circular end plates carrying the bearings. This motor takes 54 amperes at 340 volts, 900 revolutions per minute, and is primarily intended for mining purposes. The frame is of cast-steel, divided in the horizontal plane, and the poles are cast with the yoke.

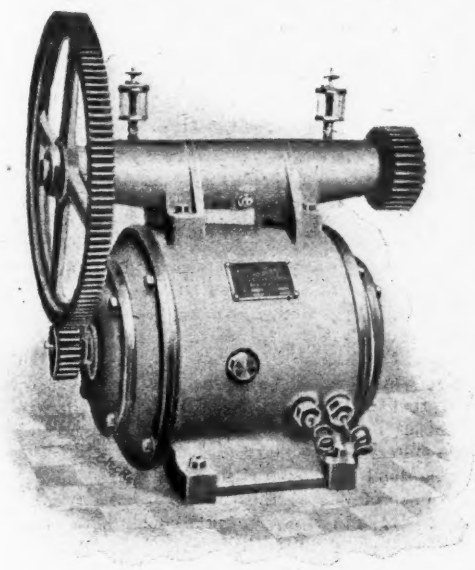
A small two-pole motor of circular shape is shown, coupled to a "Sirocco" blower; the motor takes 5·5 amperes at 230 volts, and runs at 1,700 revolutions per minute; it is provided with a neat starting rheostat having a special type of shunt breaking device.

A gas-tight motor has the end plate outside the commutator end bearing, so that the only moving part visible is the pulley shaft. A sight hole is provided, covered with a zinc guard and a glass disc bedded on a rubber pad. This motor is of 2 b.h.p., taking 8·5 amperes at 220 volts, 1,050 revolutions per minute, and is fitted with worm reduction gear having a ratio of 25 to 1. Another enclosed motor has gauze-covered ends; a fan on the shaft at the pulley end draws air in and blows it over the armature towards the commutator end. Other small motors are also exhibited; one of these drives a horizontal shaft at 35 revolutions per minute through worm gear, having a reduction ratio of 40 to 1. Very high efficiencies are claimed for this worm

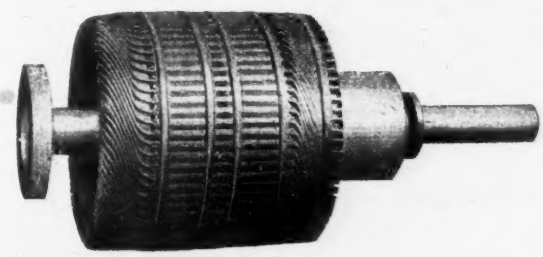
gear and the one mentioned above. The worms are cut steel and the wheels of phosphor bronze, and ball-thrust bearings are used, giving efficiencies of 85 per cent. and 91 per cent. respectively.

A different type of speed reduction is shown in the case of a 2-H.P. motor fitted with a countershaft. The pinion is of rawhide, and the wheel has machine-cut teeth, giving a ratio of 10 to 1.

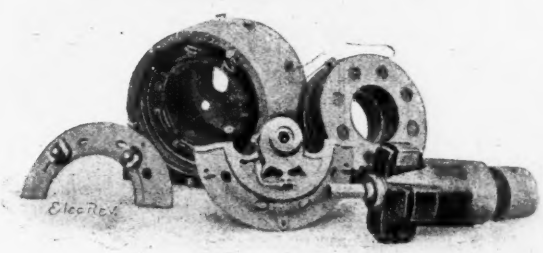
The Fynn type of alternator is represented by a 7-KW. two-phase machine giving 17 amperes in each phase at 205 volts, 60 cycles per second, when running at 900 revolutions



Enclosed Motor with Geared Countershaft.



Armature for Direct Coupling.



Parts of Small Alternator.

per minute. This machine is of the inductor type, the armature and field coils being supported by the stationary outer frame, while the rotor consists only of iron.

Two switchboards are exhibited at this stand, for 250 and 500-volt circuits respectively, both made by Mr. H. H. Wright, of Halifax; and the Electrical Power Transmission Company, of Hammersmith, contributes one of its automatic motor-starting switches, provided with slow-starting, overload and no-load release devices.

ENGLISH AND AMERICAN RAILWAY SIGNALLING.

By J. PIGG.

(*Continued from page* 583.)

Fig. 18 is a diagram of the track circuits, from which it will be seen that the system differs considerably from that previously described in other respects than those already referred to.

The track is divided into four sections, as shown by fig. 18. The first of these, beginning at A, is the preliminary section, B is the section controlling the distant signal, and the section C D is under separate control. There are four track relays, R_1, R_2, R_3 and R_4, and four batteries connected with the sections of track circuit. Two of these batteries are connected through the armatures of relays R_2 and R_4 respectively, and when the latter are not independently energised the battery circuits are broken. The other two track batteries are connected direct. M and M_1 are the relays controlling the motor circuits, and B_1 and B_2 are the respective batteries for operating the motors, B_3 is the battery for the bell circuits, and B_4 operates the relays M, M_1. The positions of the relay armatures shown by fig. 18 are those taken by the apparatus when any of the sections are unoccupied. The track relay circuits are closed, and the relays M, M_1 open.

Entrance of a train on the section A B causes the armature of R_1 to drop, and passes a current from B_4 through M, the upper armature of R_3, M_1, and the armature of R_1. If the line is entirely unoccupied, both distant and home signals are cleared by the closing of the armature circuits of M_1 and M respectively, thus closing the motor circuits from B_1 and B_2. The lowering of the "home" signal operates the circuit closer, thus closing the circuit of B_3 through the bells at the outlying switches. Further progress of the train into the section B C, results in the demagnetisation of R_2 and the breaking of the motor battery circuit B_2 at *a*, and the return of the distant arm to danger. When the train is entirely in the section B C, the relay R_1 is prevented from picking up its armature, and so breaking the circuit through M and M_1 by the demagnetisation of R_2 rendering the track battery of R_1 inoperative. The lower armature, *b*, of R_2 makes the contact by which the motor is short-circuited in order to prevent shock and damage when passing to danger, as referred to in the description of fig. 17.

Further progress of the train on to the section C D, demagnetises R_3, breaking the circuit of M M_1, and putting the "home" signal to danger with the same precautions

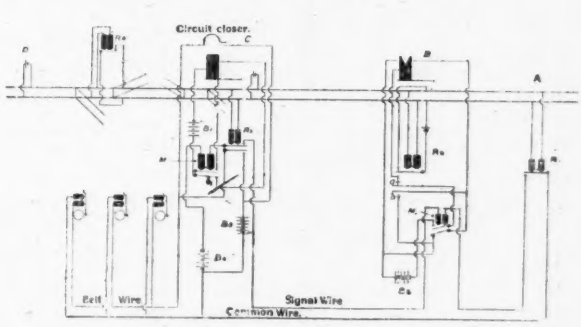


Fig. 18.—Electric Circuits for Automatic Signals for one Block Section; Hall System.

against shock. Putting this signal to danger opens the bell circuit closer on the signal, but by the dropping of the armature of R_3 an alternative circuit is made, and the bells continue to sound as long as the train is in the section C D.

The relay R_4 is practically only a track battery relay, as shown.

Should a train enter the section A B when a previous

train is in the section B, C, it will have no effect, since, as already stated, the track battery of R_1 is inoperative by reason of the short-circuiting of R_2, which opens the circuit of the motor battery at *a*.

If a train approaches A while a previous train is between C and D, the "distant" would remain at danger, and would be passed at caution. The armature of R_1 would be actuated as before, and would close its part of the circuit of M, M_1. This circuit, however, is broken by the armature of R_3, and remains so until the whole of the train has passed D. All apparatus is reset in the normal position when the train has passed D.

It will be readily seen how complete are the arrangements, and how closely they approximate to English practice, minus human control. The train is guarded by practically the same arrangements at each stage of its progress through the block. The addition of the bell at each switch in the section is for the purpose of warning trains on side tracks of the condition of that part of the section behind them when it is desired to enter the main line. Opening of the switches

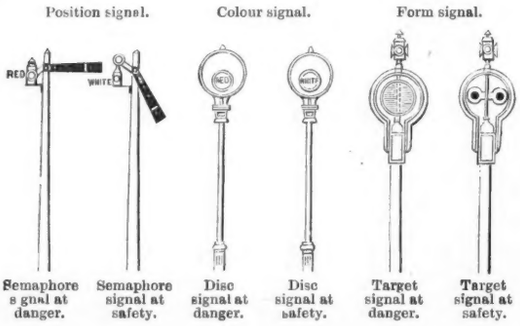


Fig. 19.—Forms of Signals in Use.

for the purpose is prohibited when the bell is ringing as this indicates the position of a train between the switch and the preliminary track section. The same rule applies to the operation of cross over switches from one main line to another. The action of opening a switch has, of course, the some effect on the track circuit as the presence of a train, and blocks the section. Hence the movement of the switch starts the bells ringing.

Some of the forms of outdoor signals used in the States are shown by fig. 19. They are described as "position," "form," and "colour" signals. In the first, which is the familiar semaphore signal—an adaptation of the apparatus used for pre-electric telegraphy—the indications are given by either of the two positions the signal arm can occupy. In the second example the indications are given by difference in colour, and in the third by differences in form. In all these cases there are only two indications given by any one signal.

There is, however, evidence of a movement in the States to adapt the semaphore to give three signals corresponding to "danger," "caution," and "clear." The first indication is given as usual by the arm when horizontal, the second when making an angle with the post, and the third when the arm is parallel with the post. It will be noticed that the "overlap" system requires only one signal at the entrance of each section, although it provides two signals at danger behind the train. The "distant" signal system, on the other hand, requires two signals. The indications given by the two signals employed in the latter system are not of the same character, but correspond to the same signals in this country, where the "home" is a stop signal, and the "distant" a "cautionary" signal. In the "overlap" system, however, there is no difference in the character of the indications given by the two signals protecting a train, and this involves, where one block is a sufficient space limit, permission to pass a stop signal when at "danger" at caution. The three-position signal is intended to combine the advantage possessed by the "overlap" system in requiring fewer signals with the more precise indications of the "distant" system. Such a system, operated by $\frac{1}{2}$th H.P. electric motors, has been recently installed on the line between Pittsburg, Fort Wayne and Chicago. The three-position signal has many advocates who claim that whilst as cheap to instal and maintain as the "overlap" its indications are as precise and distinct as those of the "distant" system.

In this country, of course, in the earlier days of railways, three-position signals giving the same indications were common, but in consequence of the effects of varying temperature on the wires by which they were operated, they were found to be unsatisfactory in consequence of the indications being

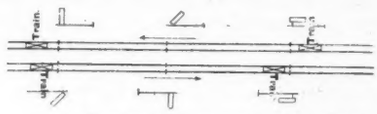


Fig. 20.—Three-Position Signalling.

less distinct from each other than is desirable. In the instances cited of American practice such disadvantages do not exist, since the signals are not manually operated from a fixed point by the aid of long lengths of wire. So long as the indications can be relied upon in their proper order, and are of sufficient distinctness from each other there can be no objection to the increase in the number of indications to be given by one signal. When these advantages are obtained, accompanied by financial economy, the adoption of such a system is only a matter of time.

Another phase of American railway signalling to which reference may be made, is sufficiently indicated by the statement that "enginemen have unrestricted power to cause calamities in however perfect a block system." The ideal block system is considered to be that in which the train in block absolutely controls the position of the signal which allow or prohibit, as the case may be, admittance to that block. By similar reasoning the conclusion is arrived at that the signal should physically prevent the entrance of a train into a block which is already occupied. Attempts to attain this desirable result seem to have aimed at independent operation of the air brake, or shutting of the engine throttle valve, but they do not seem to be used to any great extent or, indeed, to be popular with those whose actions they supervise and whose negligence they are designed to correct.

One such device consists essentially of a glass tube projecting above the engine and in connection with air brake pipes. The glass tube is broken by contact with a stout horizontal arm projecting from the signal when the latter is at "danger." When the signal is at clear the arm is lifted out of the line of contact with the glass tube. Hence, a train attempting to pass a signal at "danger" has its brakes applied automatically and is brought to a stand.

Another device provides for direct application of the air brake by operation of the valve lever by means of mechanism on the engine operated by special projections on the track, which are operative or non-operative as the signal is at "danger" or "clear" respectively. Similar devices are also made to close the throttle valve and open the whistle of the engine as occasion may require.

(To be concluded.)

THE NEW YORK RAPID TRANSIT LINE.

[The Construction of the Tunnels and Subways.]

A good deal of attention is just now being paid to the question of shallow subway railways. The recommendation which was recently made by the Parliamentary Committee on Underground Railways, and the action of the London County Council in sending two of its officials to the States to see how the idea is being developed there, is responsible for this interest.

Years ago, when the suggestion of a rapid transit railway for New York arose, it was resolved that it should be under municipal control. A Rapid Transit Commission took the thing in hand, and its engineers, under the direction of

Mr. W. B. Parsons—who, by the way, is now on a visit to this city and the Continent of Europe, to see what has been done in connection with the London and Paris underground lines—set to work upon the constructional details.

One of the first questions which arose was as to whether the line should be a deep-level line, as in London, built by boring or driving without disturbing the surface of the ground, and sufficiently deep to avoid pipes and other like obstructions, or whether it should be a subway, of the nature of a covered trench. The latter idea was adopted, and the work is now far advanced—in fact, the contracts for the power-house steam and electrical equipment have been placed, as we mentioned a few weeks ago. The roof of the trench lies immediately below the surface of the street, or as near the surface as the grade and topography will permit. In some cases this roof forms the foundation for the street paving. The method is to open a trench of the proper width and depth and remove or rearrange all interfering gas or water pipes, sewers, &c.; the roof, of concrete and waterproof material, supported on girders, is then put in place and the surface of the street restored. A deep level-tunnel, according to the estimates, could have been built at a lower first cost and without the necessity of disturbing the sub-surface structures; but, on the other hand, the greater depth would have called for passenger elevators at all stations. This would have made a very serious increase in the operating expenses, as has been demonstrated on our own City and South London line.

In the *Street Railway Review* for September, from which most of the details, and also the illustrations, contained in this article are derived, we read that the work already accomplished has substantially demonstrated the practicability of shallow construction. Only one-half of a street was disturbed at a time. The route followed avoids the Broadway, because of the great opposition encountered there, and resembles a gigantic capital Y, with its main stem and its two branches seven miles long each, making altogether 21 miles. There are two or three portions of the work that may properly be called tunnels. In January last year the contract for the construction of the centre subway was given to Mr. John B. McDonald at $35,000,000, and the contract carries with it the privilege of operating the system for a period of 50 years, and even additional renewal powers. He divided the route up into 15 sections and sublet each section to a separate contractor. It was certified that when work on the subway had been two-thirds completed, the contractor should arrange for the complete equipment of the road, including power stations and rolling stock, so that everything might be in readiness at one and the same time. As some of these contracts have now been given out, an idea of the condition of the works may be obtained. We gather that later on Mr. McDonald will transfer his operating rights to the Rapid Transit Subway Construction Company.

At one point the Rapid Transit tunnel drops below the present tunnel through which the conduit tracks of the Metropolitan Street Railway are laid. It was necessary to shore up the existing tracks as well as the old tunnel foundations, a task, while not involving new principles of engineering, called for considerable care and delicacy to avoid interruption to the street railway service, cars being run here on 30-seconds headway.

Next to the tunnel work, the most trying operations are removing, rebuilding and shifting the tangle of sub-surface pipes and similar underground obstructions. These must all be changed without interrupting the varied services. New levels for sewers and water pipes must be determined, and new locations for the telegraph, telephone, and high and low tension conduits found. At one point a sewer 9 ft. wide and 6 ft. high, which drained an area of 120 acres, was found directly in the path, and had to be replaced by other channels.

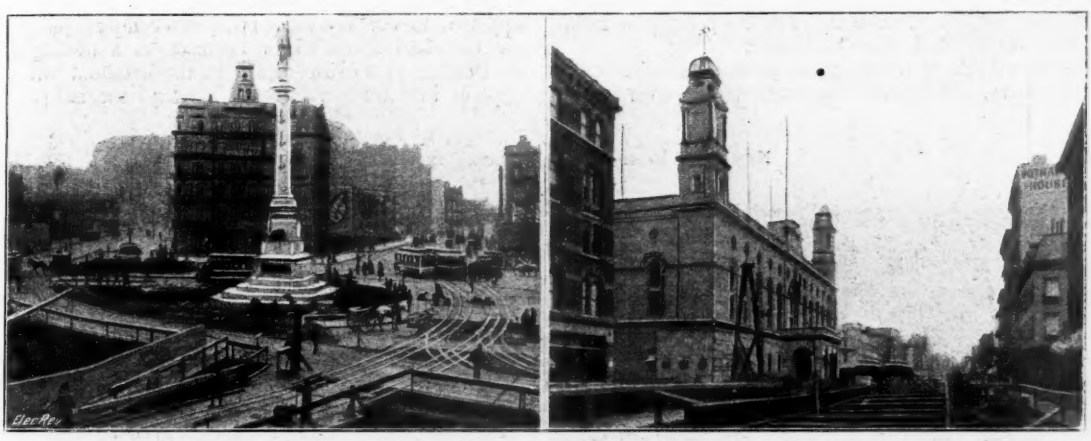
Another interesting piece of work developed at Columbus Circle. The subway here passes under the Columbus Monument and three intersecting lines of electric conduit railway tracks. The entire surface of the circle, including the monument and the tracks, had to be carried on girders during the progress of the digging.

A representative section is the one known as No. 6, on Broadway. The length of the section is 12,270 ft., the depth ranging from 20 to 45 ft., the width being 54 ft. 4 in. The contract for the section calls for the moving and rebuilding of one mile of sewers, varying in size from 15-in. pipe to 6-ft. brick, and the relaying of three miles of water pipe, from 12 in. to 48 in. in diameter. There are 650,000 cubic yards of materials to be excavated, of which one-half is rock. The excavation is being carried on in 26 different openings, the openings being full width 54 ft. 4 in.

For hoisting material four Lambert cableways of 350 ft. span are used at as many openings, and at the others, derricks, both guy and stiff leg, are used, small cars and track being employed on the bottom of the cut to bring the buckets filled with excavated material to the derrick. The tracks of the Metropolitan Street Railway, all pipes, subways, &c., are suspended by means of trusses while the material under them is being removed, so that the excavation is taken clear to subgrade without further support being necessary. When subgrade is reached for the length of the truss, posts are put in to carry the tracks, &c., and the truss is moved ahead a distance equal to its own length, and the operation repeated. These trusses vary in length of span from 50 to 85 ft., 24 pairs being wooden "A" trusses, and 10 pairs being old iron railroad bridges. These trusses are peculiarly useful in rock excavation as they give a clear space for blasting without the danger of knocking out supporting posts.

A compressed air plant comprising three 24 × 30 in. Rand compressors is being installed on the dock at 76th Street and North River. This will supply power to all drills and hoists between 60th and 82nd Streets, where the

New York Rapid Transit Subway Construction.



Under Columbus Monument. At Madison Square.

heaviest rock work is encountered. The rests of the section between 90th and 104th Streets is worked by steam drills, taking steam from large stationary boilers placed at convenient points.

The most difficult features of the section are at 65th Street, where the structure of the Manhattan Elevated Railway has to be supported, and at 71st Street and Amsterdam Avenue, where the rapid transit tunnel crosses under the street railway tracks. From 97th Street to 104th Street the tunnel is double-decked, the centre tracks being depressed to avoid grade crossings with the outer tracks at 104th Street, where the eastern branch of the tunnel leaves the main line. The lower tracks are 45 ft. below the street.

Most of the rock from the excavations is sent to the crusher at 86th Street and Broadway, and crushed to make concrete for use on other parts of the construction work. All riveting on the iron work is done with pneumatic tools.

In constructing the tunnels under Park Avenue the particular feature is the difficulty in blasting tunnels of such large section immediately under an old existing tunnel and adjacent to so much very valuable property.

The upper ends of the two branches of the Rapid Transit road will be carried on elevated structures, aggregating five miles in length, and there will be a high steel viaduct half a mile long to carry the western branch over the Manhattan Valley on the upper west side. All the remainder of the road will be underground. For the present the main line stops at City Hall, where is the terminal loop.

The general scheme for the seven miles of main line calls for four tracks, laid on the same level, the two inner tracks to be reserved for express trains, and the two outer ones for local trains. A striking feature of the design is the absence of all grade crossings. At the City Hall terminal, where connection will be made with the proposed extension down Broadway, and at 104th Street, where the branches divide, crossings at grade are avoided by depressing two of the tracks and carrying them under the other two. This layout with the scheme of terminal loops, will make the continuous and uninterrupted running of trains as near a certainty as the present art of railroad will permit.

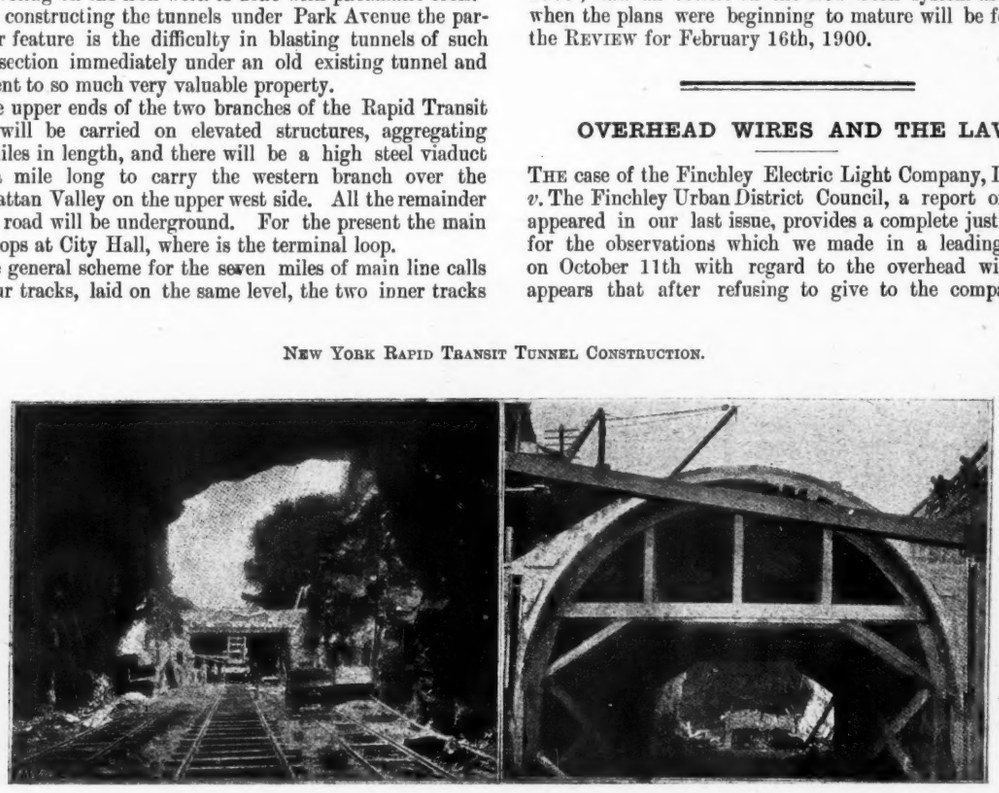
On the express tracks, subway stations will be placed at average intervals of 1½ miles. On the outer, or local tracks, the stops will be more frequent, probably about four to the mile. The stations as designed are light and airy structures, illuminated by direct sunlight from heavy glass transoms in the sidewalks above.

Care will be taken to ensure perfect ventilation at the stations and in the subway, although it is believed that artificial ventilation will be necessary in but few sections. The stations are so close together, are so near the surface, and have such ample openings into the free air, that there can be but little chance for obnoxious vapours or cellar air to accumulate. Moreover, the concrete base, walls, and roof are amply provided with waterproof layers of felt and asphalt sufficient to ensure perfect freedom from dampness. Where possible, as on the Boulevard, open space, surrounded by grass plots will be left in the centre of the street.

Early in September, as we have already mentioned, the Rapid Transit Subway Construction Company began letting contracts for the equipment of the power station which will furnish current for the operation of the subway. The Allis-Chalmers Company will supply eight engines, which will be direct connected to alternators of approximately 4,500 KW. capacity; these engines are to be of the same type as those furnished for the Manhattan Elevated power house. The Babcock & Wilcox Co. was given the contract for 48 boilers.

Those of our readers who wish to look a little further into the general question of subway railways, will find a description of the Boston Subway, with illustrations, in the ELECTRICAL REVIEW for October 1st, 1897. The Paris Metropolitan Railway was described by us on August 24th, 1900; and an article on the New York system as it stood when the plans were beginning to mature will be found in the REVIEW for February 16th, 1900.

NEW YORK RAPID TRANSIT TUNNEL CONSTRUCTION.



CENTRAL PARK HEADING — BROADWAY AND 157TH STREET.

OVERHEAD WIRES AND THE LAW.

THE case of the Finchley Electric Light Company, Limited, *v.* The Finchley Urban District Council, a report of which appeared in our last issue, provides a complete justification for the observations which we made in a leading article on October 11th with regard to the overhead wires. It appears that after refusing to give to the company the necessary permission to break up the streets for the purpose of laying their mains, the Council took the law into their own hands. The company had erected two posts on private land on either side of the Regent's Park Road. Between these two posts and across the highway, far above the reach of the traffic, they had stretched one of their cables, in pursuance of a laudable endeavour to supply electricity in the district in spite of root and branch opposition on the part of the District Council. The Council, however, would not admit they were defeated, but sent their surveyor and his men to cut the wires; whereupon the company very naturally applied to the vacation judge for an injunction to restrain the infliction of further injuries of a similar kind. His Lordship granted an interim injunction, saying:—"Upon the facts before me I must assume that in some way the plaintiffs have obtained the assent of the owners adjoining the highway to the wires being put up. The defendants are willing to give an undertaking not to cut any more wires; but that will not maintain the *status quo*. I say nothing more upon the facts before me, except that the plaintiffs are entitled to an injunction in terms of the notice of motion, the plaintiffs' managing director undertaking in damages." Of course, this is not a final settlement of the question at issue; we must await the hearing of an action at law for the satisfactory determination of this

interesting point. So far as we are aware, however, there is nothing whatever to prevent a private company, without a provisional order or other authority, stretching wires across the highway, provided sufficient precautions are taken for the safety of the public in accordance with the regulations issued by the Board of Trade. In our issue for September 20th we mentioned a number of towns and districts in which electricity is supplied without opposition and with perfect safety by means of overhead wires. Thus at Hampstead, a supply which commenced in 1892 is being furnished through 38 miles of mains, all overhead. At Northallerton, 5 miles of bare conductors are carried on steel poles, 21 feet high; while at Carlow, overhead wires have transmitted current at 2,500 volts since 1892. It is not conceivable that all these systems should have remained in working order for a number of years if they are illegal. The decision of the Lord Chief Justice, sitting as Vacation Judge, is all the more pleasing when we remember the fifth paragraph of the report recently published by the Electrical Power Mains Regulation Committee of the London Chamber of Commerce:—"*Permission to use Bare Overhead Wires.*—The committee would particularly point out the fact that the Board of Trade regulations have hitherto practically entirely prohibited overhead work in the United Kingdom, except under such onerous regulations as to make it impracticable. There are large areas in this country over which power supply Bills have been granted, the character of which is similar to districts where bare overhead wires have been successfully and safely used on the Continent and in America at very high voltages for the past 10 years. The great development of power transmission on the Continent and in America has been largely by bare overhead wires in a form which has been entirely prohibited in this country, and great industries have arisen based on their use which have no counterpart here at all. The committee are strongly of opinion that permission to use overhead wires outside crowded city areas is vital to the commercial success of power schemes over large districts, and suggest that on this point regulations should be brought into line with those current in other countries."

FACTORS OF SAFETY.

It has been suggested that factors of safety ought to be called factors of ignorance. As illustrating this we might cite the case of bridge work often supposed to be constructed with a factor of safety of six, but actually, if all stresses were taken into consideration, with very much less. Prof. R. H. Smith, in his Presidential address to the Civil and Mechanical Engineers' Society, considers that until more intelligent methods are introduced all refinements of scientific theory must remain futile. He states that Euler's formula for long struts is so faulty as to require a factor of 20. Calculations are so often made on false assumptions as to stress distribution, that safety factors are employed to cover such false assumptions. Could every stress be known and properly allowed for in calculations a factor of three would be ample. It seems to us that it is altogether wrong in any case to base strength calculations on the ultimate tenacity of any material, and that the elastic limit alone is properly to be employed. For many years engineers have had before them the results of Fairbairn's and Hodgkinson's tests on iron and have had Wöhler's law before them, but very little has been done in fitting them to calculations. For long enough Americans professed to calculate bridge work on a more scientific basis than English engineers. As a matter of fact, their science resolved itself into severe skimping of material, and much knowledge has been acquired as the result, for these too light structures began very soon to develop numerous points of weakness. Floor beams and connections failed badly, and it was soon apparent that no weight had been attached to the effect of suddenness of application of load in imparting stresses. As weak points have shown themselves, different unit stresses have been applied to the parts affected. This seems to us to be bad practice. All parts ought to be allowed the same unit stress, subject to Wöhler's law, but the loads ought to be truly calculated with every allowance for impact and wind pressure, &c., before the calculation of dimensions is proceeded with. Factors of safety for corrosion are, we think, out of place. We would prefer to add to sectional areas an amount to be corroded away during the expected lifetime of the structure, and in this we find ourselves in accord with Prof. Smith, who would proportion such additions according to the size and shape and environment of the part, square or round sections obviously requiring less addition than flat and thin pieces. A factor of safety or marginal factor is, of course, always necessary to cover variation of material, but this should not be great, for material can now be obtained of very regular quality, and pieces of minimum strength are, or ought to be, nearly as strong as pieces of maximum strength. Prof. Smith considers that experiment shows the modulus of elasticity to vary less than the ultimate strength, and this supports the contention in favour of neglecting ultimate strength. The modern tendency is towards more accurate determination of stresses and less extravagant safety factors. Prof. Smith hints at factors as little as $1\frac{1}{3}$ and seldom above 2, and the higher factors would only be applied to the extent of the moving or casual load stresses, and not to the dead load stress. These low factors, of course, are applied to results calculated from the limit of elasticity and not from ultimate tenacity.

CORRESPONDENCE.

The Ethics of Ordering Machinery Abroad.

When our ancestors first started manufacturing, and found that with labour they could make certain raw material more valuable, they began to increase the wealth of the country; this wealth has gone on increasing ever since, and it is entirely due to labour.

The articles representing this wealth are for ever changing, some wearing out, some being used up to make other articles still more valuable, some being sent abroad to buy raw material for consumption in one form or another, but always, while we labour, increasing.

Long ago, directly the smith had turned a lump of iron into an axe, the wealth of the nation increased by one axe, and if he exchanged it for something else, the nation was none the poorer.

Later, when we found we could manufacture articles and send them abroad, we got value for them in one way or another and started our export trade, which is vitally necessary to us now that we cannot grow sufficient provisions for ourselves.

The most serious blow to this increase of wealth to the nation, which may even bring about a decrease, is the present fashion of ordering manufactured articles from abroad.

Every atom of wealth due to labour on articles used in England, ought to be in England and not given to the foreigner.

The electric plant imports for this year up to a recent date amounted to £637,000; of this, the value of the raw material, as it is found, or imported to our country, is not £100,000, the balance being for labour in one form or another; we have thus made a present of over £500,000 to foreigners.

The excuse for ordering abroad is first, cheapness, and secondly, delivery.

Cheap the machinery may be to the individual buyer, Corporation or private individual, but it is dear to the nation; if the electric plant ordered abroad had been made at home, and invoiced to the buyers at higher prices even, the nation would have been the richer; it would have used up the raw material, but it would have the plant and also the value of the labour spent on it; whereas now it has the plant and the raw material, but has sent the value of the labour abroad.

As to delivery; we, the nation, made the mistake in legislating, so that we could not see our way to put our own money into electrical ventures for our own convenience; when we found this was getting unbearable, we changed it, and instead of allowing time to make up for our error, we

were in such a hurry to get cheap tram rides and cheap light, both luxuries, that we threw our money abroad to get the machinery, instead of lending it to our manufacturers to increase their old, or put down new works, to make our own plant and increase our wealth.

If the money given to foreigners this year had been sunk in a new and properly equipped works in this country, it would have added to the nation's wealth over 100 per cent. yearly.

Percy Rosling.

The Falk Weld.

In a recent issue of your Journal there is a paper by Mr. J. More on "Recent Tramway Practice," in which the Falk weld is mentioned. We are the exclusive representatives in the United Kingdom for the Falk weld, and should be much obliged if you would be good enough to insert the following statement regarding this type of joint.

We are willing to guarantee that the conductivity of this joint will be equal to the conductivity of the rail itself, and that this will be the case two years after the joints have been made. We are also willing to guarantee that the total breakages within the first two years will be under 2 per cent.

As all those connected with track work are aware, the life of the track depends on the life of the joints. Where mechanical, and especially electrical, traction is adopted, up to the present no mechanical joint has yet been discovered which will prevent hammering after, say, two or three years' service. This hammering diminishes the life of the rail, as well as increasing the cost of maintenance, trucks, motors and cars. By putting in Falk welding this trouble is entirely done away with, as the joint becomes the strongest portion of the track.

As regards the question of actual welding, it is, of course, impossible that an actual weld should take place between the cast-iron and the steel of the web of the rail. In practice, however, it has been found that the assimilation between the cast-iron and the steel is so great that if an attempt is made to pull these apart, the cast-iron will bring away with it parts of the web of the rail.

We shall at all times be glad to give information to any persons interested in Falk welding, both as regards the cost of doing this work under different conditions, and as to the royalty which we would want should Corporations or companies wish to do the work themselves.

Robert W. Blackwell & Co., Limited,
B. Hunting Howell,
Managing Director.

London, E.C.,
October 17*th*, 1901.

American Trading.

As illustrating the business methods of certain American firms, and *à propos* of the last paragraph of an article in the Electrical Review for October 11th, the following may be of interest to you :—

A non-technical friend of mine wrote to the makers of a small petrol motor fitted to a launch, in America, asking for detailed explanations of the functions of certain cocks, valves, &c., fitted to the motor. The answer he received after six weeks was, "Put it in the water and see!"

E. E. Hankinson.

Electric Road Vehicles.

The article by Mr. W. E. Warrilow in your issue of October 18th, 1901, directs the attention of station engineers and mains superintendents to a possible economy, and reads well; but why must the steam motor be given the palm for simplicity and repairs and maintenance by staff? Electricity is in its infancy until every generating station—I might say public and private—has an adequate panel devoted to cells on charge.

Imagine (*à la* Gilbert and Sullivan) the mains superintendent asking his chief which he may draw from the station, liquid fuel, coal, or coke, or a few ampere-hours, except at "peak" times! The writer is an engineer having expert knowledge of electric vehicles from experience in this country and abroad. There are others; and all who know from practice the wonderful simplicity of adaptation and operation (yet, there are limitations) of the motor, controller, and cells to vehicle work will agree that here with slow speed, iron tyres, limited range of operation, cheap current, all under the eye of electrical engineers, is an ideal commercial field for a type of motor car, which does not, apparently, possess sufficient glamour to command a respectable share of the force motif of the A.C.G.B. & I., &c., *vide* letter by Mr. Chambers, printed on page 653 of your issue.

J. Sutherland Warner.

Electricity Supply at St. Petersburg.

I notice in your current issue that the three electric lighting companies in St. Petersburg have now arranged to charge a uniform price of 3½ copecks per hectowatt. This works out to an equivalent, in English money, of 8¾d. per unit. In comparing this price, however, with the maximum in this country, it should be borne in mind that it has to cover the cost of imported Welsh coal, in order to comply with strict regulations in regard to the smoke nuisance, and on which an import duty of 4s. per ton has to be paid.

In addition to this, the electric lighting companies have their concessions for about 40 years, at the end of which time the whole undertaking passes into the hands of the local authorities without any payment whatever.

From this it is obvious that the combination between the competing companies was very necessary, and it is satisfactory to see that this has been accomplished.

Charles A. Baker.

London, W., *October* 22*nd*, 1901.

Traction Tragedies.

I think it would be of interest to your readers if you invited engineers in charge of traction contracts to relate some of the experiences they have undergone, and at the same time give their views of the treatment they have been subjected to by the various Corporation officials while carrying out these contracts.

I have no doubt that this correspondence would prove most interesting, and considering the number of these contracts now on hand, would be beneficial, and doubtless instructive to many of your readers.

Headlight.

[Undoubtedly such experiences would be interesting; we trust, however, that any engineers who adopt "Headlight's" suggestion will endeavour to restrain their feelings, and to confine their phraseology within the limits allowed in polite circles!—Eds. Elec. Rev.]

ELECTRICAL MATTERS AT THE LONDON COUNTY COUNCIL.

The Council on Tuesday resolved to advance £25,000 to the Hackney Borough Council for electric lighting purposes, £6,380 to the St. Pancras Council for arc lighting works, and £7,480 to the Hampstead Council for mains and £2,810 for meters.

Electric Car Sheds.—The adjourned report of the Highways Committee stated that it would be necessary to provide additional car sheds specially constructed for the housing of electric cars, and that if steps were not taken in that direction at an early date there would be a serious danger of delay in the working of the tramways. The electric tramcars would be of greater size and more numerous than the horse cars at present in use, and some of the existing car sheds could not be adapted for electric cars, whilst a large expenditure would be involved in the adaptation of some of the others. It would therefore appear advisable that in anticipation of the necessity for more car sheds, measures should be taken as soon as possible for the acquisition of sites which might be available for the purpose. Attention had been called to a suitable site at New Cross Gate, about 7½ acres in extent, where a large car shed and other accommodation could be provided. As the owners would not voluntarily dispose of the land the Council decided to apply for compulsory powers to acquire the site in the next session of Parliament. It was also decided to apply for similar powers in relation to land adjoining the Clapham depôt.

Companies and Street Opening.—The Highways Committee presented a report in reference to the resolution which was passed some time ago by a conference of metropolitan local authorities to the effect that the time had arrived for concerted action to be taken to remedy the inconvenience, annoyance, loss of time and money caused by the operations of the gas, water, telephone and electric lighting companies in laying down, renewing, maintaining and repairing their mains, pipes, services and wires. It appeared to the Committee that it had become absolutely necessary that as the central authority for London, the County Council should be invested with power to exercise effective control over such works. If the Council were to make a representation to the Government with a view to obtaining such powers, that course would meet with the general approval of the London local authorities and the public. It would also probably be considered favourably by the Government, as the Home Secretary had inquired what action the County Council proposed to take in order to give effect to the resolution adopted by the conference. The frequency of the breaking up of the roads had, moreover, been the subject of questions in Parliament, and provided a proposal to confer such powers upon the Council were to receive strong support from the local authorities, the Committee stated that it would probably have a fair prospect of being adopted by Parliament. If the Council approved of the suggestion, it was first intended to lay the matter before the local authorities in order to ascertain their views. The Committee therefore recommended the Council to ask the City Corporation and the Borough Councils whether they would be prepared to support the County Council in making a representation to the Government as to the necessity of legislation to confer upon the Council powers to make and enforce bye-laws or regulations as to the manner in which companies and others should exercise their statutory rights to break open the public thoroughfares, and as to the time at which such works should be commenced and completed, and the surface of the roads re-instated. After a long discussion, the recommendation was adopted with the addition of words to provide that the companies should be compelled to move their pipes or wires into any subways constructed by the County Council.

Electric Traction on the North Metropolitan System.—The Highways Committee submitted a further report on the course to be taken to give effect to the provisions of the London County Tramways (Electrical Powers) Act, 1900, which authorised the Council to reconstruct for electric traction the tramways on the north side of the Thames leased to the North Metropolitan Tramways Company until 1910. The lease contained clauses providing for the adoption of electric traction on specified terms, but it appeared some time ago that instead of putting those provisions into force, the reconstruction could be hastened if the company's interest in the lease could be acquired by the Council. The company had, however, declined to name any price for the surrender of its lease, and the Committee had therefore endeavoured to find some way of expediting the introduction of electric traction on the lines. Having regard to all the circumstances, it appeared to the Committee that the time had arrived for the Council to act upon the provisions made in the lease for that purpose. The Committee, therefore, asked for authority to give notice to the company of the Council's intention to put in force the provisions relating to the use of electric traction, and the Council decided to give the necessary permission.

Tube Railways.—The Parliamentary Committee brought forward a long report in relation to the inquiry held by the Joint Committee of the Lords and Commons on underground electric railways in London. In the opinion of the Committee the conclusions of the Joint Committee to a large extent supported the views expressed on behalf of the Council during the course of the inquiry. The Committee stated they were not yet in a position to advise the Council with regard to the action which should be taken as a result of the inquiry, but they felt that, although the Joint Committee did not definitely lay down any detailed scheme for railway extension and development in London, the recommendations would prove valuable as a guide in dealing with the suspended Bills, and with any other schemes which might come before Parliament on a later occasion.

THE TELEGRAPH AND TELEPHONE SERVICES OF AUSTRALIA.

The Committee of Electrical Experts, which, as we have intimated on several occasions in these columns, has been investigating the entire question of the telephone and telegraph services in the Australian Commonwealth, has issued a very important report. It is abstracted in several of the Australian papers, and for the following summary we are indebted to the *Melbourne Argus* for September 10th:—

The report is a very bulky document of 150 printed foolscap pages, and the members of the conference, Messrs. H. W. Jenvey (Victoria), J. V. Nelson (New South Wales), J. Hesketh (Queensland), and Sir Charles Todd (South Australia), deal with the telephone and telegraph systems of the Commonwealth in a comprehensive manner. The experts open their report by making the subjoined recommendations regarding the Victorian telephone system:—

A general scheme for improving the telephone system in the metropolitan area is that of—

1. Metallic circuits laid underground in tunnels and conduits.
2. The extension of the present exchange building to a sufficient extent to enable the putting up of a new switchboard, and at the same time continue to work the old one.
3. The purchase of a common battery switchboard, with all necessary accessories, to be fully equipped with jacks, &c., for 5,000 subscribers, and to have an ultimate capacity for 10,000; also for providing for an entirely new stock of subscribers' instruments on the common battery system should it be found necessary to use new instruments for this purpose instead of converting the present instruments. This is a very serious question, so that if it is found that the present instruments, instead of being discarded and made a total loss of, can by proper measures be converted to suit the common battery system at less cost than that for new instruments, and with equal efficiency, it is highly desirable that this should be done.

The scheme of distribution, as at present laid out, more particularly with reference to what may be called the city proper, covers an area of 67 square miles.

The first item in the system of distribution is a tunnel from the telephone exchange in Wills Street down Queen Street to Flinders Street; the length of this will be 1,232 yds. From this tunnel cables branch east and west to Spring Street and Spencer Street, and it is proposed to lay these in four of the smaller streets, and from these to distribute to all the blocks within the area mentioned. For this purpose both underground and aerial cables will be required. The underground cables in the branch streets will be laid in conduits. Branching cables will extend from these conduits to the centre of each block, and from these conduits to the centre of each block, and from these centres aerial cables will be placed in suitable positions on racks, so that the final distribution will be made by means of open wires to the subscribers. It is also proposed to lay conduits and cables on the main suburban routes out of the city to points sufficiently remote to enable the present congestion of wires immediately external to the city to be relieved.

This description indicates the general plan of installing the new system for the central exchange. It is not proposed at present to proceed with any alterations to the suburban exchanges, which it is considered can be worked satisfactorily on the existing systems as indicated in the recommendation of the engineer. The estimated total cost of the improvements referred to is as follows:—

Telephone cables	£73,130
Laying, &c.	7,313
Conduits	54,653
Racks	5,400
Manholes and drawpits	4,000
Tunnel	11,088
Switchboard	30,000
New common battery telephones	24,000
Extension of building	10,000
Assistance	6,800
Total	£226,384

The estimated expenditure for the first year is	£64,288
The estimated expenditure for the second year is...	81,800
The estimated expenditure for the third year is...	80,296
Total	£226,384

The Committee recognise that this is a large expenditure, but it is to be remembered that the whole of the present Melbourne telephone system requires immediate and complete attention if a satisfactory service is to be given. No single section of the works named can be omitted without prejudice to the success of the other sections. It is not practicable to take any half-measures, and it is impossible to stand still. Extensions must be made at once if current demands are to be met. These must be on the new system, as the present board will not accommodate new subcribers for more than two years, and cannot be extended. Its full capacity will be reached before the new board could possibly be erected. The Committee, therefore, endorse the recommendations of the telegraph engineer, and recommend his scheme for approval.

Turning to the telegraph lines of this State, the report states that "repairs, especially re-poling, are much required on most of the telegraph pole routes. The vote for annual repairs, extensions, and renewals, which was 10 years ago £15,000, was, owing to retrenchment, gradually cut down to £3,000, a sum altogether inadequate to keep the lines in repair; the consequence being that the work has fallen into arrears, and a great deal of expensive renewals have now to be made."

The New South Wales telephone system requires an outlay of £93,001, in the opinion of the experts, to bring it up to date; the South Australian system £86,800, and the Western Australian system about £41,000, but the Queensland system is reported to be well up to modern requirements. In all, the conference recommends an expenditure of £446,000.

The experts believe that a trunk telephone line between Melbourne and Sydney would be a "financial and commercial success," and recommends its erection. The cost is estimated at £50,000, using wooden 30 ft. poles to carry the cable. Interest and maintenance are placed at £2,650 per annum, and on the assumption that there would be 35 conversations a day between the two capitals for 300 working days, they work out the probable revenue—at 6s. 6d. per conversation of three minutes—at £3,412, thus showing a profit of £763, after taking the "most disadvantageous view of the expected business." The rate is arrived at on a general scale suggested for long-distance lines of 6d. for the first 25 miles, and

3d. for each additional 25 miles. The cost of constructing the proposed line would be distributed:—New South Wales, £33,700; Victoria, £16,300.

The Conference recommends that the toll system of payment for telephone service should be substituted for the present flat or fixed rates. Under the toll system there would be a fixed annual charge to each subscriber to cover interest and sinking fund on the average capital outlay, together with a minimum number of free calls, and an additional charge for every call beyond the minimum. The present rates in Victoria are: Business telephones, city and suburban, £9 per annum; country, £7; private residence telephones, £5. The scale proposed by the Conference is:—

Exchange subscribers.	Annual ground rent.	Free calls.
5,000	£4 10 0	300
20,000	5 0 0	300
20,000 and upwards	6 0 0	300

With extra calls respectively—1 to 1,000 1d. each, 1,001 to 5,000 ½d. each, and 5,001 to 20,000 ¼d. each.

Until the various telephone systems are brought into a state of thorough efficiency, however, the conference recommends that the existing fixed rates should not be interfered with.

To overtake business after the main telegraph lines have been interrupted, and to permit of the rapid transmission of press matter, the conference suggests that provision should be made for the introduction of the Wheatstone automatic system between Melbourne and Adelaide, Sydney and Brisbane, at an estimated cost of £3,000. "Such a system would not," it states, "affect to any appreciable extent the ordinary traffic, which is composed of short messages, each to a different address, the fast-speed system being peculiarly adapted to long messages to be dealt with quickly, and where the same dispatch has to be transmitted to many addresses."

The report recommends the Ericsson and solid-back transmitters instead of the Berthon-Ader telephones now in use, multiple switchboards, the metallic circuit system, and undergrounding of cables in glazed earthenware or cement conduits. Iron poles are said to be vastly superior to wooden poles, and eventually far cheaper. The suggestion is made that telephone subscribers may telephone matter to be posted on payment for the first 20 words 6d., for every additional 20 words 3d., and that telegrams should be transmitted by telephone at 3d. for the first 20 words—plus, of course, the telegraph charge—and 1d. for each additional 10 words.

The conference considers that the operating staff of the larger telephone exchanges in the Commonwealth should, during the day, be composed of female officers, because "it is the invariable experience that for this class of work girls or women, if carefully selected, are as quick, more polite, and generally give a more satisfactory service than boys or men." From 8 o'clock a.m. and 8 p.m. it is urged that female operators should be employed, and for the service between these hours youths; the rate of pay for all telephone officers to be, first year £30, second £40, third £55, fourth £65, and fifth £80.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 23rd, 1900.	Value
Alexandria	£41
Amsterdam	30
Bombay	246
Buenos Ayres. Teleg. mat. ..	200
Calcutta	683
,, Teleg. wire	223
Cape Town	25
Colombo	248
Copenhagen. Teleg. wire ..	136
Durban	202
East London	60
Fremantle	214
Gibraltar	34
Gothenburg	160
,, Teleg. wire ..	396
Hamburg	60
,, Teleg. mat.	200
Hiogo	48
Hobart	210
Hong Kong	103
Karachi	72
Lyttelton	68
Madras	108
Malta	150
Melbourne	47
Monte Video	30
Nagasaki. Teleg. cable ..	6,602
Ostend	118
Penang. Teleg. mat.	138
Perth	222
Port Chalmers	109
Port Elizabeth	301
Rotterdam	37
,, Teleg. mat. ..	45
St. Petersburg. Teleg. mat. ..	225
,, Teleph. mat.	182
Seychelles. Teleg. instruments	11
Sydney	914
Valparaiso	81
Vancouver	19
Wellington	108
Yokohama	474
Total ..	£13,555

Week ending Oct. 22nd, 1901.	Value
Alexandria. Teleg. mat.	£123
Amsterdam	105
Bangkok	90
Bombay	472
Calcutta	1,470
,, Teleg. cable	197
Cape Town	152
,, Teleg. sundries ..	106
Colombo	263
Copenhagen. Teleg. wire ..	248
Durban	359
Flushing	13
Fremantle	16
Gothenburg. Teleg. wire ..	44
Hamburg	11
Hong Kong	750
Melbourne	43
Nagasaki	1,560
Penang. Teleg. mat.	58
Port Chalmers	720
Rotterdam. Teleg. wire ..	26
Shanghai	137
Stockholm. Teleg. cable ..	914
,, Teleg. wire ..	60
Sydney	569
Yokohama	2,162
Total ..	£10,668

Foreign Goods Transhipped.

Barbadoes.	Teleph. apparatus	£54

Auction Sale.—Messrs. Wheatley Kirk, Price & Co. will on November 6th and 7th offer for sale by auction at the premises of Clayton, Howlett & Co., Atlas Works, Woodfield Road, W. (who are removing to Sheffield), the motive power plant and machinery, stock, stores and other effects.

Books Received.—"Research in the Scottish Universities," by James Gordon Macgregor, F.R.S. Edinburgh: James Thin. 1901.

"Production et Distribution de l'Energie pour la Traction Electrique," by Henry Martin. Paris: Ch. Béranger. 1902. Fr. 25.

"Problèmes d'Electricité," by A. Raadot. Brussels: A. Manceaux. 1901.

Buffalo Exposition.—The Pan-American Exposition at Buffalo closes on November 1st.

Cable Steamer.—It is said that an order for a steamer for laying cables for a Continental Government has been placed with David J. Dunlop & Co., Port Glasgow.

A Country House Installation.—Admiral Rowley is having complete electric lighting and water supply plant erected at his residence, "Holmesland," near Botley, Southampton. Here Messrs. Merryweather, the London engineers, are fixing a powerful oil engine and dynamo, and wiring the whole of the buildings. Accumulators are to be provided to keep the light going during the night. An electric motor is to drive a pump at a well some distance away to supply roof tanks, whence the water is to be distributed by pipes for domestic supply and fire protection.

Dissolutions and Liquidations.—A petition for the winding-up of the Telephonic Bell-Push Syndicate is to be heard in London on October 30th. The petitioners are W. P. Thompson and Co., of High Holborn, W.C.

Creditors of the British Electric Works Company are to send particulars of debts to Messrs. H. E. Abbott and W. C. Spencer, liquidators, (at the office of Chalmers, Wade & Co., 5, Fenwick Street, Liverpool) by November 30th.

Messrs. J. G. S. Cunnington and H. K. Smith (Laing, Wharton and Cunnington, electrical engineers, 93, St. Martin's Lane, W.C.) have dissolved partnership. Mr. Cunnington, who continues the business under same style, attends to debts.

The Clayton Engineering and Electrical Construction Company, Limited, resolved on September 20th to wind-up voluntarily for purposes of reconstruction. Mr. Maurice Whiteley, 17, Knight Street, Hyde, is the liquidator. The name of the new company will be the Clayton Engineering and Electrical Company, Limited.

The petition presented by R. Wheelock, of Birmingham, for the winding-up of the Hampstead Electric Supply Company is to be heard on October 30th, before Mr. Justice Wright.

The Edwards Electrical Company, of 19 and 21, Queen Victoria Street, is winding-up voluntarily, with Mr. A. E. Darville as liquidator.

A meeting of the Okonite Company will be held at Finsbury Pavement House, E.C., on November 27th, to hear an account of the winding-up from the liquidator, Mr. E. J. Palmer.

The Electrical Transmission Company, of Albert Works, Beavor Lane, Hammersmith, writes to us with reference to a notice which appeared on page 628 of our last issue, asking creditors of the Electrical Transmission Company, Limited, to send particulars of debts, &c. We have pleasure in drawing attention to the fact that the Electrical Transmission Company, *Limited*, has no reference to the Electrical Transmission Company, of Hammersmith.

France.—La Société Française des Electro-Moteurs Itschner is the name of a company which has just been formed in Paris.

Meters for Cape Town.—The Electric and Waterworks Committee of the Town Council recently urged the latter to direct and authorise arrangements to be made for the importation of 100 electric meters, of various sizes, through the London agents, as soon as possible. The Committee were advised that it may be possible to procure one dozen 5-ampere electric meters from Messrs. Findlay & Co., at a cost of £4 10s. each, and recommended that they be authorised to purchase these additional meters. The report was adopted.

Trade Announcements.—The New Brotherton Tube Company, Limited, have opened offices and stores at 9A, New Brown Street, Manchester, under the superintendence of Mr. Albert Moulding, where a large stock will be kept of enamelled steel conduit tubes and fittings for electric wires.

Messrs. Preece & Cardew have removed their offices from 13, Queen Anne's Gate to 8, Queen Anne's Gate, Westminster.

Messrs. G. Boor & Co., chemical merchants, recently removed from Artillery Lane to 39, Mincing Lane, E.C.

What the British Consuls have to say.—*Electric Tramways of Palermo (Sicily).*—Consul Sidney Churchill, reporting on the trade of Sicily, states that during 1900 the tramway system of Palermo was extended to 30,774 metres—19 miles—the overhead cable system being mostly adopted. The line, which was used by about 4,000,000 passengers in 1899, is said to have added about 50 per cent. to its traffic by its conversion to the electric system.

Electric Lighting at Argostoli.—Vice-Consul Saunders in his report on the trade of Cephalonia (Ionian Islands), makes mention of the fact that electric light has replaced petroleum in the town of Argostoli, and he gives the details of the undertaking. He states that the Town Council having decided upon adopting electricity for the lighting of the town, entered into a contract with the Thomson-Houston Electric Company, which ceded the contract to the

Hellenic Electric Company in Athens, retaining, however, an interest in the concern. By the terms of this contract the municipality engages to pay to the company 30,000 fr.—£1,200—a year, the company, on the other hand, engaging to supply the town with 300 lamps, each of 16 c.p. The contract is for 60 years, at the expiry of which period the premises with machinery and plant become the property of the municipality. The current is supplied to the public at the cost of 7l. in paper, or a little under ½d. per hour per 16-c.p. light, the cost of the installation being from 30 to 50 dr. —say from about 14s. 7d. to £1 4s. 6d., at 41 dr. per £1 sterling—according to the size and quality of the lamp required.

Electric Railway from Santa Cruz to Laguna.—This railway, which was constructed last year, Consul Croker, of the Canary Islands, reports, will doubtless prove a great boon to the inhabitants of Laguna, the second town of importance in Teneriffe, having a population of 13,000, and of the port of Santa Cruz. Laguna is five miles away from the port, having an elevation of about 1,800 ft., and is the favourite residence of the wealthier classes during the warmer months of the year. It is proposed to carry the railway to Orotava, the well-known health resort on the north side of the island, thus bringing the three towns within easy reach of each other. The railway was built by a Belgian syndicate, who obtained a concession from the Spanish Government for 60 years, the capital involved in the scheme being about £64,000.

Electric Lighting of Varna (Bulgaria).—Vice-Consul Brophy reports that a provisional concession has been granted for lighting Varna by electricity, the estimate being for 50 arc lights of 10 amperes each, and 1,500 lamps of 16 c.p. The concession, when ratified, will be for 40 years. There being no water-power available, the generators will have to be driven by steam engines.

Electrical Industry in Hamburg.—The use of electricity, both for lighting and locomotion, Consul-Generel Sir W. Ward states, continues to increase at Hamburg, and in other parts of that district, at a rapid rate. The electricity works of Hamburg furnish the current required, both for the very extensive and complete tramway system of Hamburg, and of the adjoining town of Altona, as well as for the entire consumption of electric light, with the exception only of two blocks of buildings which have their own system. According to the latest annual report issued by the electricity works, it was anticipated that this year an even greater increase in the total consumption of electrical current would take place than last year, in consequence partly of the completion of a third large central station for supply of current, and also in consequence of the electric lighting—at the expense of the town—of all the more important streets and thoroughfares of Hamburg which has been carried out. The following figures show the number of consumers, and the amount of electric current supplied during the last two years:—Number of consumers in 1899, 3,099; in 1900, 3,770; equivalent in incandescent lamps, 171,397 and 209,650 respectively; current for the tramway system, watt 3,190,000.

Bordeaux Tramways.—Consul Hearn reports that these lines have been steadily converted from horse to electric traction, the whole of the electric system being completed in May last. An electric tramway has been opened from Pierrefitte to Cauterets, and from Pierrefitte to Luz, in the Pyrenees.

ELECTRIC LIGHT AND POWER NOTES.

Benwell.—The U.D.C. has passed a resolution in favour of putting in force its electric lighting prov. order.

Blackburn.—The controversy upon high speed *v.* low speed engines for electricity supply in Blackburn still continues, letters pouring in to the local press upon the relative merits of the two types. Alderman Thompson, chairman of the Electricity and Tramways Committee, gave an explanation of a personal character, to the effect that when he found that one of the firms tendering for the high speed engines was a concern in which he held preference shares, he immediately instructed his brokers to sell, and thereafter attended no meeting of the Committee until his financial interest in the firm was ended. The whole matter is thrown into confusion, and nothing will be done until the new Council is elected and a new Committee chosen.

Bolton.—After some delay the electricity department of the Corporation has obtained the assent of the Finance Committee to the proposed application to the B. of T. for sanction to borrow £125,000 for electric lighting, traction, &c. Roughly speaking, it is proposed to spend the money as follows:—£25,000 on building extensions, reservoir, and cooling tower; £62,000 on new boilers, engines, firing floor, and engine foundations; the remainder to be expended on new mains, services, meters, &c. When this sum is expended, the capital of the department will stand at about £322,000. The capital cost per kilowatt, as represented by that sum, is £46 or £47, Bolton occupying the seventh position in this respect among 127 stations, and the second (2·23d. per unit) in low selling price, while it is sixth in order of merit for low cost of production (1·34d.). Owing to the substantial sum being set apart for depreciation, it is believed that all the machinery in the station will have been paid for ere its "life" is ended. It is proposed to carry out the work covered by the new capital expenditure only as the needs of the town may prompt during the course of the next half dozen years. The present output is 2,800 kw. It is proposed to add 20 Lancashire boilers, two sets of engines and generators, each of 900 kw. capacity, and two of 1,200 kw. capacity each, thus, with the original plant, giving an effective power of 7,000 kw. at the station. The present maximum load at the works is 1,840 kw. It is also proposed to extend the condensing plant, so as to run the whole of the engines condensing, as it has been found that since installing this, a saving of 16 per cent. in coal has been effected.

Bootle.—From 50 applicants for the position of electrical engineer to the Corporation, the committee has chosen the following six candidates for a final selection:—Messrs. T. D. Clothier (Hull), H. Drewett (Morley), J. Lambert (Perth), W. F. Long (Chorlton-cum-Hardy), W. M. Rogerson (Nottingham), and J. M. Smyth (Keighley). The starting salary is £350 a year.

Brecon.—The T.C. at their last meeting considered the provisional order for the electric lighting of the town obtained by Colonel John Morgan and presented to the town. It was decided to engage Mr. Bertram Thomas to prepare a report on the undertaking. The Mayor said he thought the cost would be from £8,000 to £10,000.

Bristol.—The new civic electrical station at Bristol is being pushed forward as rapidly as possible in order that it may be ready for taking a share of the winter load. The present station at Temple Back will be severely taxed until the extension is ready. At the best this cannot be until the beginning of December. The station is built on low-lying meadow land between the Avon and the Feeder rivers on the outskirts of the city. The ground was not piled, but rows of trenches cut through it until, 30 ft. down, hard red marl was met with, and on this basis massive concrete foundation walls were erected. These were connected at the surface with a bed of concrete, and in the superstructure weights were so arranged that they came directly over one of the walls. To give additional stability, the area of the engine and dynamo room was given an extra layer of concrete 8 ft. thick, resting on three of these longitudinal foundation walls. The first instalment of plant consists of two Willans-Siemens steam alternators, each of 750 kw., equal to an emergency load of 920 kw., and each capable of lighting simultaneously 30,000 lamps of 8 c.p. They will get their steam from Babcock & Wilcox boilers, fitted with superheaters and Green's economisers, and working up to 200 lbs. per square inch. The automatic stokers are of the Meldrum pattern, adapted to work with cheap fuel when a full load is not required. The coal will descend by gravity to the stoking gear from large bunkers in the top of the building, into which it is to be delivered by a travelling conveyor, which, on its return journey through a gallery beneath the stoking corridor, picks up the ashes. The conveyor works from an elevator pit, into which the fuel is brought from the barge lying in the Feeder river by an overhead travelling arrangement, crossing a public road in its journey.

Coventry.—When Mr. J. A. Jeckell took charge of the electricity works he found that the capital expended amounted to £75,813, and that the capacity of the plant was 550 kw.; allowing for reserve, the net earning capacity was 350 kw., which, therefore, cost about £217 per kw. Under these conditions the capital charges alone amounted to 2·8d. per unit, and as the works costs could hardly be brought below 2·52d., the lowest possible total cost was 5·32d., more than 1d. higher than the average price obtained. Mr. Jeckell, therefore, recommended the Committee to treble the earning capacity, while doubling the capital; to reduce the price charged for the third and subsequent hours from 3d. to 1d. per unit; to calculate the rebate quarterly instead of half-yearly, and to charge 1½d. per unit for power and heating. These recommendations were unanimously adopted by the Committee at their last meeting. It is hoped that by this bold step the capital charges and the works cost will be reduced to 1·75d. per unit each, making a total of 3·5d. per unit, while the output will be trebled by reducing the price from 4½d. to 3½d. per unit. We trust that by this means the department will at last be enabled to "turn the corner"!

Croydon.—The sanction of the L.G.B. has been received to a loan of £30,000 for electric lighting.

Gillingham.—The U.D.C. has decided to apply for a prov. order for the purchase of the Chatham Electric Light Company's works and undertaking in that part of the district.

Gravesend.—A L.G.B. inquiry has been held into the application of the T.C. for leave to borrow £31,500 for electric lighting purposes, by Mr. H. P. Boulnois.

Hamilton.—The B. of T. has warned the T.C. that the prov. order, granted in 1898, is likely to be revoked if it is not carried into effect.

Hucknall Torkard.—The U.D.C. is to apply for a provisional order for electric lighting.

Hyderabad (India).—The *Indian Daily News* says that "With reference to the application submitted by Messrs. Roughton & Byrne on behalf of Messrs. Dick, Kerr & Co., for the grant of a concession by the Nizam's Government for the supply of electric light and electric power in Hyderabad, the Cabinet Council, in accordance with a resolution passed at its meeting held on the 7th Meher, 1310, Fasli (May 14th, 1901), submitted an Arzdasht on the case to His Highness in Firman, dated 13th, Jamadulaval, 1310 Hirji"!

Italy.—The engineer Mario Azari has applied for a concession to take water from the River Adda, in the Province of Sandrio, in order to produce in four different establishments 32,700 h.p. This power, transformed into electric power, would be distributed at Milan for motive power purposes, and along the route

for lighting purposes. The construction of the necessary works is estimated to cost 8,800,000 lira, and the working expenses are estimated at 1,031,000 lira annually.

Liverpool.—At the last meeting of the municipal year, held last week, the Corporation passed a high compliment on the work of Mr. A. Bromley Holmes, city electrical engineer. The output up to the end of December last was for lighting and power, 4,888,653 units; for traction, 6,675,682 units; for the current year it is estimated that the output will be for lighting and power, 6,250,000 units; for traction, 14,000,000 units. The number of lamps connected up to September 1st, 1901, was 167,239 of 16 c.p. equivalent. The prices charged are 4d. for lighting, 2d. and 1½d. for power.

London.—City.—The Court of Common Council has instructed the Streets Committee to consider the desirability of obtaining Parliamentary powers to regulate the opening of the public streets.

Woolwich.—A special meeting of the B.C. was to be held yesterday to consider a proposed application to the B. of T. for a prov. order to supply electricity in that part of the parish of Woolwich, south of the Thames, and to carry into effect the terms of the agreement between the Woolwich District Electric Light Company, Limited, and the Council, for the purchase by the Council of the said company's undertaking.

Southwark.—The B.C. has decided, with reference to the proceedings commenced two years ago for an injunction restraining the City of London Electric Lighting Company from permitting black smoke to issue from their works at Bankside, Southwark, to settle the action, which is still waiting to proceed to trial, on the basis of the company paying the whole of the Council's costs and giving an undertaking to use every possible means to prevent smoke in the future.

Camberwell.—The B.C. is to consider next month an application to the B. of T. for a prov. electric lighting order.

Middleton.—The Gas and Electricity Committee have fixed the charges for electricity at 5½d. per unit for lighting and 2½d. for power.

Newburn.—The Council has given consent to the Newcastle and District Electric Lighting Company, Limited, applying for a provisional order for the supply of electrical energy in Newburn, Lemington, Throckley, and Westerhope.

North Berwick.—As the result of the recent plebiscite, the T.C. has resolved to proceed with the agreement with Messrs. Crompton & Co., Limited.

Paignton.—The U.D.C. has received notice that the Provincial Electric Supply and Traction Company intends to apply to the B. of T. for a prov. electric lighting order.

Paisley.—A report has been submitted by Messrs. Mordey & Dawbarn in connection with the supplying of motive power generally, and the electricity works and their requirements for providing energy for the projected electric tramways. The reporters had no doubt that the system as prevailing in Paisley could, with the necessary additions, be used for the tramway system. This matter was of great importance, not only because of the large amount of energy wanted, but because of the effect it would have, if undertaken by the Corporation, on the economy of the general supply for all purposes. In an interview which they had had with Mr. Parshall, consulting engineer to the tramway undertakers, they learnt that, subject to the necessary financial arrangements being made, he anticipated that a service of 40 to 50 cars would commence in from 15 to 18 months, and that 70 to 80 cars would ultimately be required. Assuming that 40 cars were used, the energy used annually would be about 1,000,000 units, which would produce an income of about £6,146, or 1·475d. per unit. The tramway load would be a very favourable one, because of its amount and steadiness, and because it would involve no distribution losses or expenses. The report further dealt with extensions, &c., required for the increased consumption, the cost of which was estimated at £38,000. The works, it was pointed out, had not been working long enough to enable an opinion to be formed as to the sufficiency of the present charges to make the undertaking profitable. That they were not at present covering expenses was partly due to the system being larger and more complete than was necessary for the present output. This would, of course, remedy itself as the demand increased. Another part of the deficit was due to the very low price charged for the street lighting. This would be remedied by a fair adjustment between the two departments concerned. The deficit on this account should not in any case be regarded as a loss to the Corporation. The effect of the tramway load would be to bring in a profit of about £2,566 a year. There was thus a practical certainty that, within a very short time, the electricity department would be working profitably. The report was adopted, and it was agreed that Mr. Parkinson, burgh electrical engineer, prepare a statement as to the cost of supplying and erecting plant to provide energy for 40 tramcars.

Southampton.—The deputation appointed to visit other towns in search of the qualifications of certain electrical engineers reports having obtained information which will be exceedingly useful to the Committee.

Sunderland.—The new electric generating station is now ready to generate current. The work was only commenced at the end of March, so that it reflects great credit on all concerned. Next week a start will be made with the supply. The original station has been very much taxed, owing to the demand for traction and power purposes, as well as for lighting.

Swindon.—Last week Mr. W. O. E. Meade-King held a L.G.B. inquiry into an application by the Corporation for sanction to borrow £31,000 for electric lighting purposes. Sanction has already been obtained to the borrowing of £3,000 for the purchase of a site for a generating station. The contract for the three engines and dynamos has been provisionally placed with Messrs. Siemens Bros. & Co. Mr. Lacey, of the firm of Lacey, Clirehugh and Sillar, explained the scheme.

Tipperary.—The U.D.C. favours the proposals of the Ampere Electrical Company to provide electricity supply in the town.

Tiverton.—A public meeting is to be held on the electric lighting question.

Tyldesley-with-Shakerley.—The U.D.C. is to apply for a prov. order.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramways Committee has recommended the Council as follows:—

(1) That the rate of commission to be allowed on the capital outlay in connection with the works referred to in the account (including rolling stock) should be fixed at 2 per cent. (2) That in future the maintenance of the electrical equipment of the tramway plant and lines should be undertaken by the tramway department and the electrical engineer relieved of this work. (3) That as regards the equipment of new lines, the electrical engineer and his staff should be available, if required, and that the rate of commission to be allowed for their services should be fixed at 2½ per cent. on the capital expenditure. (4) That the tramway feeder cables should continue to be maintained by the electricity department at the expense of the tramway department. (5) That the proportion of the electrical engineer's salary, at present paid by the tramway department, amounting to £50 per annum, should cease to be borne by that department.

The Corporation have under consideration the question of adapting electrical traction to the most important section of the city tramways, and reports on the subject have been submitted by the burgh surveyor and the electrical engineer. The engineers are of opinion that a considerable outlay would be necessary in renewing and adjusting the existing track for the efficient working of the system by electricity. It is also estimated that the total cost of equipping the sections in question on the span-wire system from rosettes will be £2,839, or, with 10 per cent. added for contingencies (£284), £3,123. Meanwhile another large extension of electric tramways in connection with the city is in contemplation. Steps are being taken by a syndicate, headed by an American engineer, to promote a Bill in Parliament for power to construct an electrically equipped tramway from Woodside—the northern limit of the city boundary—to Dyce, a suburb some six miles into the country. As there is a considerable population *en route*, it is believed that such a tramway line would pay handsomely, but the most strenuous opposition will be offered by the Great Northern Railway Company, whose suburban train service has supplied the district for many years. Another scheme being promoted by the same syndicate is the construction of an electrically equipped tramway from Mannofield, a western suburb of the city, to Culter, on Deeside, a distance of about six miles. The district here is not so populous as on the Dyce route, but the promoters believe that, nevertheless, a tramway here could also be made to pay. On the other hand, the scheme would meet with equally strong opposition from the Great Northern Railway Company, whose Deeside line runs along practically the same route as that suggested for the tramway.

Batley and Dewsbury.—December 1st has been fixed as the date of completion of the contract for the sale of the Batley, Dewsbury and Birstall tramways to the British Electric Traction Company, Limited. To avoid the cost and delay involved in the appointment of a liquidator, the company intend to ask the shareholders to accept the purchase money direct from them.

Berlin.—The Berlin correspondent of the *Daily Chronicle* says that the remarkable development of electric tramways from Berlin to the suburbs threatens to inflict a heavy blow on the hitherto existing local railways. The statistics of the last half year's traffic point conclusively to a falling off in the number of passengers conveyed by rail. The tramcars are driven at great speed, averaging 20 miles an hour. They are run every 5 or 10 minutes, and no matter how great the distance, the fare is only 1d. A new overhead electric line, which will run from the east to the west of Berlin, will be opened for passenger traffic in about a month. Trains will run 25 miles in the hour. The fare from one end of the city to the other (about 4 miles) will be only 1½d.

Birmingham.—The Tramways Committee has reported in regard to the tramways in Bristol Road, as the result of the representations made by them to the City of Birmingham Tramway Company, as to the noise occasioned by the passage of the cars on these tramways, that new rails are being laid down at the cost of the company, which, it is believed, will minimise the noise.

Bombay.—The *Englishman* states that the Brush Company are preparing to actively proceed with the task of taking over the Bombay tramway system, and converting it to electric traction, under the terms of the concession obtained from the Bombay Cor-

poration. The company's engineer, Mr. A. B. Cooke, who has been deputed to inquire into the local conditions and requirements affecting the undertaking, arrived in Bombay in September. Mr. Cooke will prepare a report on the existing conditions, with full estimates, for the company, with a view to actual work being commenced as soon as possible. In addition to the conversion of the tramways, an installation of electric light and power is also under consideration.

Rowley and Blackheath.—The B.E.T. Company has intimated its intention to promote a scheme for tramways from Blackheath to Oldbury. The Rowley Regis U.D.C. has decided to appoint a committee to consider the scheme in conjunction with representatives from Dudley and Oldbury. The Council will also act jointly with the Dudley T.C. in obtaining the requisite order for the construction of light railways from Dudley through Rowley Regis to Blackheath.

Brighton.—The Brighton and Shoreham Tramways Company are said to be about to introduce electric traction, and desire to extend their system to Worthing.

Bristol.—The Special Committee of the Council appointed to negotiate with the Tramway Company for the purchase of their electrical undertaking, at its first meeting selected Mr. George Pearson (chairman of the Civil Electrical Committee department) as chairman. "Unofficial" terms were submitted to the committee to give an idea of the company's proposals, and it was decided to ask a representative of the company to attend the next meeting to discuss the subject. The general impression in Bristol is that the company is not only willing but desirous to sell, and the motive which has led to this attitude has been the theme of much local discussion. There are not a few who believe that Mr. George White and his directors wish to free capital from a concern having only 15 years to run before the city can purchase under the Tramway Act, for fresh enterprises elsewhere. This is, of course, based on pure conjecture.

Britonferry.—The Margam D.C. are opposing a scheme of the Glamorgan County Council for the construction of a light railway from Britonferry to Taibach. It was stated that the expense would be £500,000 to £600,000. The District Council have obtained powers for electric lighting, and they argue that when the proper time comes they can utilise the power for traction. The county authority has dropped the scheme for the present.

Carshalton.—The U.D.C. having considered a letter from the B.E.T. Co. showing the details of the proposed tramway lines and street widenings, the Council expressed itself in favour of the introduction of electric tramways into the district, and decided to take a poll of the electors on the 28th inst.

Croydon.—The R.D.C. is giving further consideration to the proposed tramway schemes affecting their district, and has received an intimation that the Board of Trade will confirm without amendment the Council's application for an order for the construction of tramways at Mitcham, notwithstanding that the application had been powerfully opposed. The Council also received notification from the Beddington and Wallington Parish Councils objecting to tramways in their districts. During the same meeting, Mr. Devonshire, a representative of the B.E.T. Co., had an interview with the Council, pointing out, *inter alia*, that his company were applying for the transfer of the Mitcham provisional order, in order to secure through connection between Croydon and Wimbledon; the company will also effect a junction with the L.C.C. tramways, and they ultimately intended to extend their system to the Crystal Palace. After discussion, Mr. Devonshire was asked to make three separate offers in writing for the acquisition of the order, viz., the payment of a lump sum, arrangements for repurchase, or for financing the system *pro tem.*

A curious accident occurred last week on the Croydon electric tramways. Two cars were passing the points at North End, when the trolley arms came into contact, with the result that one of the cars was incapacitated and had to be taken back to the car-shed in the tow of another tram.

Derby.—A deputation from the Tramways Committee visited Glasgow on 15th inst. and inspected the Corporation electric tramways and power house.

The Derby—Ashbourne light railway order (1901) has been confirmed by the B. of T. after modification.

France.—An important project, having for its object the construction of a line of electric tramways intended to connect the towns of Marseilles and Aix, is now under study. The enterprise has been in abeyance for some time past, owing to the refusal of the Paris-Mediterranean Company refusing to allow the proposed tramway to intersect their line. The concessionnaire and the railway company have, however, at last come to terms, and the work will be proceeded with without delay. The line, which will be of the overhead system, will start from the extremity of the Cours Mirabeau at Aix, and proceed *viâ* Pont de l' Arc, Luynes, Trois Pigeons, Albertas, Violési, Le Pin, Septemes, Notre Dame, and Saint Antoine to Marseilles. The tramway will be constructed with a view to dealing with goods as well as passenger traffic. The gauge will be of 1·44 metre, the line being single or double, according to the exigencies of the locality traversed. A minimum of 16 journeys in each direction will be made daily, at an average speed of 20 kilometres per hour. Each train will be composed of three carriages, and of a total length of 30 metres. There will be two classes for passengers, the fares being at the rate of ·075 f. per kilometre in first class, and ·05 f. in second class. Return tickets, available for two days, will be issued at a reduction of 25 per cent. The Postal authorities will utilise the tramway for the carriage of the mails, and, in addition, each tram will be provided with a letter-box for telegrams and express letters. The concession lasts till 1950.

The Engineer of Ways and Bridges of Thiers, in the Department of Puy-de-Dôme, has informed the Communal Council that an application has been made by Messrs. Taverdon & Chabassas for the concession of a line of tramway between Thiers and Saint-Remy-sur-Durolle. The proposed line would be about 15 kilometres long, and would obtain the necessary electric energy from a waterfall on the course of the Credogne.

Good progress is being made with the construction of the electric tramways at Lille. When completed the lines will have a total length of 86 kilometres.

Farnham and Haslemere.—The proposals to connect Farnham and Haslemere with electric tramway are being considered by the L.U.T., Limited, and the Imperial Tramways, Limited. It is suggested that a single track would be sufficient for most of the distance, and that only small cars need be used. The proposed tramways would serve as an important feeder to the S.W. Railway Company.

Glasgow.—The recent action brought against the Corporation by a retired civil engineer for running the cars at an excessive speed has been dismissed by Sheriff Fyfe, he finding the charge not proved. In the evidence it came out that the Corporation had authority from the Board of Trade not to exceed 10 miles per hour; also that they had obtained an extension of time—six months—in which to fit speed indicators, after which they might be permitted to run at a speed not exceeding 12 miles per hour. It is thought by many that this action was brought on with the concurrence of other concerns; the popularity of the tramway system causing the directorate of the District Subway to considerably reduce their fares, and the suburban railway companies to run their trains with more punctuality.

Greenock.—The Greenock and Port-Glasgow Tramway Company have decided not to run their system of electric cars on Sundays, pending a decision of the Board of Trade on the matter regarding their right to do so, which has been disputed by the burghs of Greenock and Gourock. Their application for licenses for 20 new cars has been delayed by the Greenock magistrates, who hold that the height of the step from the ground—17 in.—is an element of danger.

Greenwich.—The M.B.C. has received notice from the L.C.C. of their intention to introduce a Parliamentary Bill next session to construct tramways along the Blackheath Road, Shooter's Hill (to the Herbert Hospital), and thence along Woolwich Common Road, Thomas Street, New Road and Mill Lane, Woolwich, and Blackwall Lane to Blackwall Tunnel; also from New Cross to Eltham. The question of posting the necessary street notices was referred to committee.

Ham.—The U.D.C., in reply to the Surrey C.C., expresses itself as opposed to the construction of any tramway through Ham and Petersham, both on account of the narrowness of the roads and the rural character of the scenery.

Huddersfield.—The sub-committee appointed to investigate (1) the cost of the conversion of each section converted to electricity; (2) the saving in cost of working already effected by conversion; (3) possibilities of further economies by complete conversion, &c., &c., have presented their report, from which we take the following:—As to cost of conversion for work already done the figures are: Power station, £30,969; electrical equipment, £33,848; rolling stock, £15,834; new permanent way, £35,874; or a total of £116,527, or £2,103 per mile old track, and £4,445 per mile new track. As to saving in cost of working already effected by conversion, the sub-committee compiled balance-sheets of the working of the steam and electric sections for the 13 weeks, March 14th to June 8th. The steam section showed a loss, after allowing for depreciation, interest and sinking fund, &c., of £2,511 12s. 5d., or 6·723d. per car-mile. The loss on the electric section was £1,664 1s. 5d., or 2·83d. per mile. This was prior to the commencement of the running of Sunday cars. As to (3), the possibility of further economies by complete conversion, the sub-committee state that the sooner the conversion of the whole system to electricity is proceeded with the better. The financial charge per car-mile would only be increased a halfpenny, whilst the actual cost of haulage would be reduced to 4¾d. The power station is already adapted for receiving the machinery necessary to run the whole system. On the whole, say the sub-committee, with complete conversion of the existing system and a gradual and judicious use of the powers already possessed for extensions, the sub-committee is of opinion that a point may be reached at which the undertaking will prove remunerative.

The sub-committee recommended the extension of the electric system from Manchester Road, along Outcote Bank, Manchester Street and Market Street, down Westgate to Kirkgate.

The tramway receipts for the month of September, 1901, were (steam) £1,860 17s. 5d., or 13·34d. per mile; electric, £2,490 19s. 9d., or 11·51d. per mile, which, jointly, is an increase of £1,200 upon the corresponding period last year.

The Tramways Committee on 7th inst. resolved to equip Newsome Road (steam) section electrically at a cost of £1,608. It is also proposed to extend the Lockwood and Berry Brow section to Honley (3 miles) and equip electrically. These recommendations were, on Wednesday, 16th inst., received and adopted by the Council, with the additional resolution that having regard to the irregularities in the tramways department, and complaints against

the management, the Tramways Committee be invested with plenary powers to deal with the same.

Later information says that upon consideration of the report of a sub-committee appointed to investigate certain charges made in regard to the management of the tramways, the Tramways Committee has decided to call upon the tramways manager (Mr. J. Pogson) to resign his position, and to itself set to work to reorganise the traffic department. The borough treasurer at once took charge of the traffic office.

Halifax.—The British Electric Traction Company having asked the Corporation of Halifax whether that body would approve of an interchange of traffic as between the Corporation routes and certain neighbouring routes of the company, has received the reply that the Corporation does not see the advantage of any such arrangement.

Italy.—The electric tramway from Milan to Monza, the first inter-urban electric line in Italy, is now in full working order. The installation was ordered from the Mediterranean Thomson-Houston Company by the Edison Company, which also exploits the Milan city tramways, transformed in 1897. The Milan—Monza line is about 17 kilometres long, and, like the Milan city tramways, utilises the electric current developed by the Paderno Falls, situated at a distance of 33 kilometres from the city. The rolling stock comprises 14 auto-cars and 10 trailers. The carriages are elegant and spacious, the motors being mounted on double bogie trucks, and capable of accommodating 48 passengers each. Each motor car is provided with two motors of 50 H.P. each, and electro-magnetic brakes. The trailer cars are also provided with similar brakes. In spite of the fact that these towns are connected by railway, the intensity of traffic on the new tramway speaks fully for its success, and on many days during the last couple of months the number of passengers has exceeded 8,000 in a single day, and it speaks well for those concerned that not a single accident to rolling stock material has yet been reported.

A prize of 5,000 lira has been opened at Padua for an account of the various applications of electricity in different countries for the operation of railways by the aid of water-power.

Limerick.—The Limerick Electric Tramway Company, Limited, have lodged a memorial with the Clerk of the Privy Council, praying for an Order in Council to authorise the construction of the Limerick Electric Tramway, &c.

Liverpool.—At the last meeting of the Tramways Committee for the present municipal year, Alderman Petrie in responding to a vote of thanks passed to him for his services as chairman of the Tramways Committee during the year, referred to the progress and success of electric tramway traction in Liverpool. The work of the Committee, he said, had been onerous and responsible, and had gone on as successfully as the most sanguine could have expected. The tramway system of Liverpool now comprised 100 miles of track worked by 350 cars carrying over 2,000,000 passengers per week, over an average distance of 2¼ miles for 1d. The cars made about 8,500 journeys a day in and out of the city, the service on some routes being as frequent as 1½ minutes and the average being about 3 minutes. The number of passengers carried in the first nine months of the present year was 75 millions, against 29 millions in the corresponding period of 1897. The traffic returns for the period had been £350,000, against £219,000. The gross profit for the present year up to September 30th had been £115,000. After providing £75,000 for interest and sinking fund and maintaining the whole system, there was a net profit of £40,000 for the nine months.

L.C.C.—The Highway Committee of the L.C.C. proposes to acquire a site at New Cross Gate, at present the property of the Haberdashers' Company, for the erection of sheds for the accommodation of electric cars.

Margam.—At the last meeting of the D.C. Mr. Enoch Danes gave notice that he would move that the powers obtained for the electric lighting of the district be carried out, and that the advisability of establishing an electric tram service between Aberavon and Taibach be considered.

Mitcham.—The Board of Trade have confirmed the application of the Mitcham Parish Council (acting through the Croydon R.D.C.) for a provisional order to construct light railways in their district, to connect both with the L.C.C. and Croydon C.C. tramways, and in spite of vigorous opposition from the water and gas companies, the order was passed without a single amendment. The matter was discussed in camera.

Newcastle.—The Corporation is to promote a new Bill in the forthcoming Session of Parliament for powers to extend the city tramways in three directions; westward to Benwell, northward to Seaton Burn, and eastward to Walker district—if possible in the latter case to Wallsend. The latter line will open up a tremendously thickly populated district in a way that is much needed. Walker and Wallsend are two thriving townships on the north bank of the Tyne, and both are centres of a dense population, being in the very heart of the Tyne shipbuilding centre. There are good railway services, but as there is no real break in the river side, it being practically one continuous town from Newcastle to North Shields (although under different authorities), the need for a tramway service for this eight miles of town will be at once apparent..

The official inspection of the first portion of the electric tramways is fixed for November 4th. For some months past the town has been without any system at all.

Oldham.—The Springhead D.C. have approached the Oldham Tramways Committee with a view to the latter laying down lines and equipment and working tramways in their district. They have been told to submit a scheme to the Committee. In consequence of an accident, the Committee have requested the Electricity Committee to place electric lamps at each terminus where the trolley of a car is changed from one wire to another. The Committee have accepted an offer of Mr. Rhodes to erect on trial an apparatus for the prevention of accidents through the falling of overhead wires.

Perth (W.A.).—It is announced that, subject to the concession being granted, arrangements have been made to extend the Perth electric tramway system to the Osborne Park Estate.

Potteries.—The Potteries Light Railways (Extensions) order has been submitted to the B of T. by the Commissioners for confirmation.

Railways and Electric Traction.—The *Financial Times* says that Mr. Nathaniel Spens, managing director of the Stock Conversion and Investment Trust, has just issued a circular to the proprietors of the London and North-Western Railway (in which the trust is interested to the extent of £1,100,000) inviting opinions on the suggestion that the directors of the line should be asked to invite a conference of railway chairmen and some leading stockholders to consider "(1) What steps should be taken to lighten the serious loss which has fallen upon the stockholders in consequence of the increased costs of working which have risen since the passing of the Railway Rates Act of 1891; and (2) what attitude is to be adopted by the railways in regard to the development of electric traction throughout the country." In regard to (2), it appears almost certain that this mode of traction will bring within urban limits and conditions districts which have hitherto been deemed quite outside—in other words, that urban traffic may well be extended to 15 or 50 miles, or even a greater radius, as contrasted with the present 4 or 5 miles. Already railways like the Metropolitan and District have had to face the making of the requisite alterations to their systems. The North London, in which the North-Western is greatly interested, is another line which will, no doubt, have to consider its position; but the whole question bristles with difficulties and with possibilities which, according as they are wisely and promptly dealt with or postponed, ignored and deferred, may mean the greatest difference to the stockholders of the existing railway companies. "Many people are of opinion that, wisely handled by the railway companies, electric traction may enable them to solve most of the existing difficulties of suburban traffic with great advantage and profit to the public and themselves. But it is also felt that other conditions might arise which, whilst securing to the public further facilities of traction, might do so no better than existing railways could, though under these altered conditions there might arise large depreciation and loss to the railways on capital expended for developing such traffic on their existing systems." The circular concludes by expressing the hope that the stockholders addressed will see their way to approve what is proposed.

Spain.—A meeting of capitalists was held the other day at Bilbao for the purpose of studying a project for the construction of an electric railway of narrow gauge across the Pyrenees, along the valley of the Ribogorzana.

Stroud.—The Gloucestershire C.C. has practically vetoed the scheme for laying down an electric railway in the district. Messrs. T. Nevins & Son, electrical engineers, who have recently completed a system of electric tramways for Cheltenham, had turned their attention to Stroud, and had offered to construct a line radiating to the neighbouring towns of Chalford, Stonehouse and Nailsworth. All the local authorities have passed resolutions supporting the scheme, but on Monday the C.C., by 15 votes to 11, declined to sanction it unless the line is laid from Stroud through Painswick to Cheltenham. It is now considered highly probable that the entire scheme will be abandoned.

Sunderland and South Shields.—The B.E.T. Co., which is desirous of promoting a light railway to be worked by electricity from South Shields to Sunderland *viâ* Whitburn, Cleadon and Harton, and whose application was not entertained by the Light Railway Commissioners, is preparing a Bill to be brought before Parliament for that purpose.

Twickenham.—The L.U.T. Co., Limited, have commenced the work of construction in this district, and are putting up poles to carry the trolley wires from the Bush Corner, Isleworth, to Twickenham.

Yarmouth.—A commencement was made on the 16th inst., without any ceremony, with the laying of the tram rails. The scheme is one of 4 miles of street route, and the total outlay is estimated at £69,000, including street improvements. About 1,000 tons of tram rails of the girder type are being supplied from Belgium. The British Insulated Wire Company, Prescot, will carry out the overhead equipment and the supply of poles. The Telegraph Manufacturing Company will provide the cables, and Messrs. Askham Bros. & Wilson, Sheffield, the points and crossings. The type of car to be used has not been definitely settled, as the Corporation have not as yet decided whether they will work the trams themselves or lease them. It is expected that the laying of the tram rails will be completed by next April.

(*Continued on page* 679.)

ELECTROMOTORS, LIMITED.

During a flying visit to Manchester we had an opportunity of going through the shops of Electromotors, Limited, under the guidance of Mr. Longbottom, the works manager.

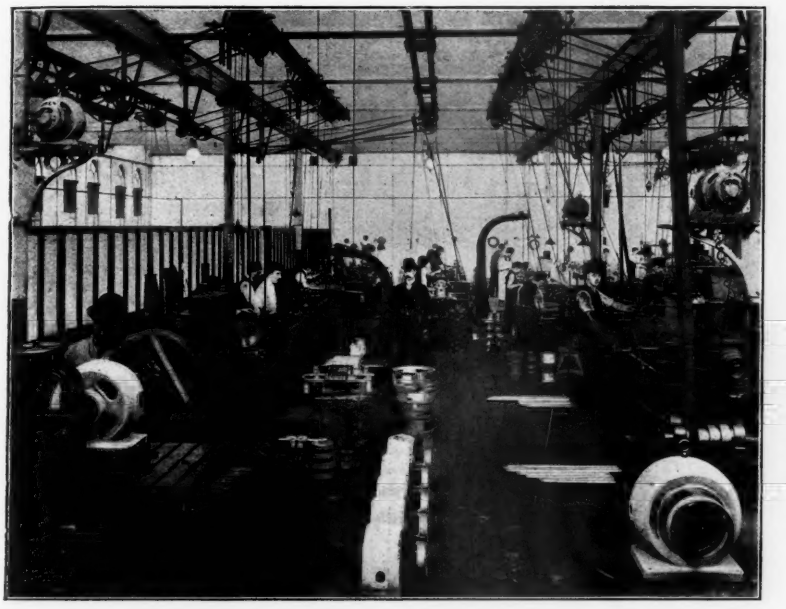


Fig. 1.—View of the Machine Shop.

It seems that the centre of gravity of the engineering world, especially so far as electrical engineering is concerned, is gradually shifting towards Cottonopolis, and it is not a little surprising to see the large amount of work being done in the electromotor industry alone in that district. The possibilities of electrical work there are exceptionally great, as is evidenced by the numerous plots which have been taken on the Trafford Park Estate, Limited, for the building of huge electrical works, some of which are now in active operation. But for the moment we are not concerned with these, but with Electromotors, Limited.

The company was formed with the view of supplying a reliable and cheap motor of home manufacture, which would compete with the importations from America and the Continent.

Immediately after the incorporation of the company a plot of land over 15,000 sq. yds. in area was bought at Openshaw—the great engineering district of Manchester—for the purpose of building works specially adapted for the above object. Plans were drawn out and the buildings proceeded with.

In the meantime temporary premises were taken in Hulme, so as to enable the company to make the necessary experiments and complete as far as possible the making of gauges, templates, jigs, &c., in order that the manufacture might be energetically proceeded with on installation at the new works.

The company removed from Hulme to Openshaw at the beginning of this year, and by the end of March everything was in full working order.

The offices are detached from the main building and are well arranged, comprising workmen's entrance, timekeeper's lodge, main entrance, waiting room, works manager's office, secretary's office and board room, drawing and general offices.

The pattern shop and castings store is another detached building to the left of the offices, and the pattern shop itself is equipped with the most modern tools, which are electrically-driven.

The castings shop is of ample proportion, the floor space being capable of stocking 150 motor bodies. In addition there is a series of bins, each marked with the pattern number of a motor part, and designed to store sufficient parts to complete the above-mentioned quantity of bodies. To facilitate machining, every casting is pickled before being sent into the works.

The main building comprises:—Boiler and economiser house, engine house, drying room, workmen's dining room, winding room, machine and erecting shop, tool room, stores, testing room, and the packing and delivery department.

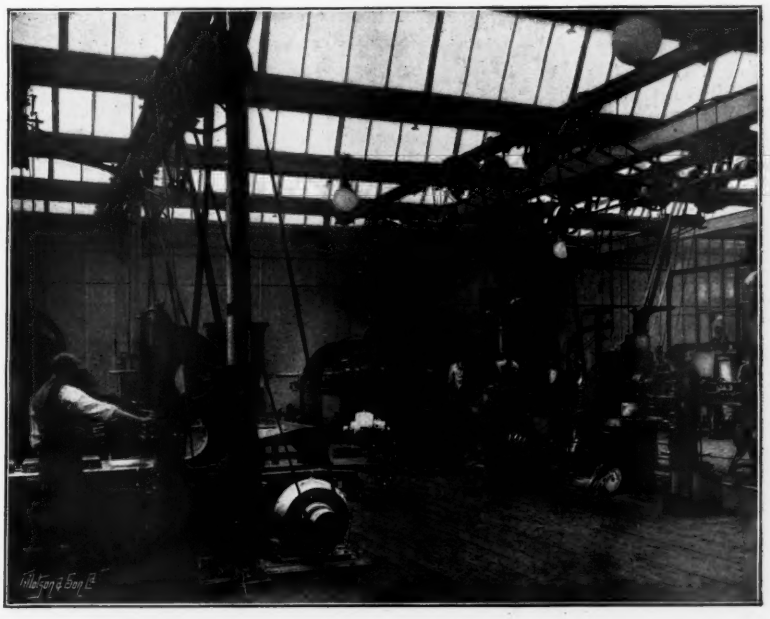


Fig. 2.—Another View of the Machine Shop.

Rails are laid between the castings store and the main building to facilitate transhipment.

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The steam raising plant consists of a Lancashire boiler of 300 H.P. worked at 150 lbs. pressure, and made by Edward Heaton & Son, Manchester, and is so arranged that an additional boiler can be fixed when required. A Green's economiser of 96 pipes is also in use, and this is electrically-driven.

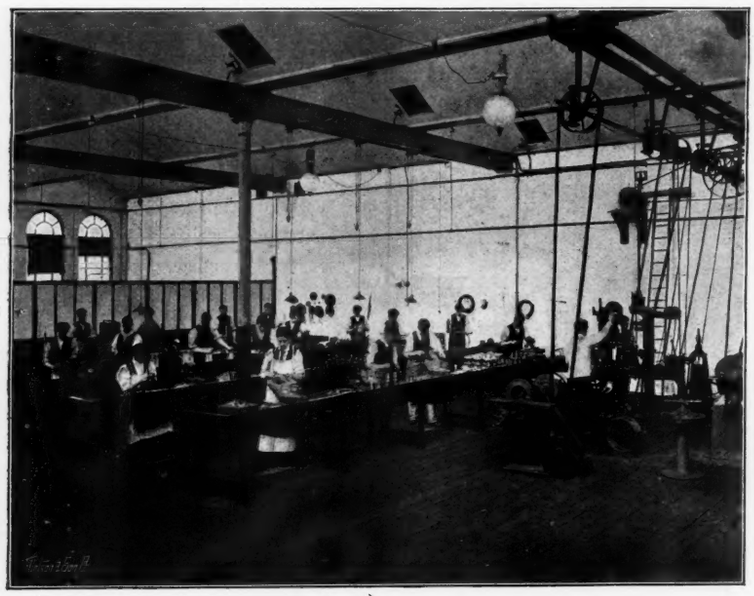


Fig. 3.

The engine house contains a 100-KW. Holmes generator direct-driven by a Browett-Lindley vertical two-crank compound engine of the enclosed type, fitted with a Ledward condenser. There is also a combined lighting and power switchboard made by Messrs. Cowans, Limited, Manchester.

The shops and yards are well lighted by 44 arc lamps of the G.E.C. standard pattern, and incandescent lamps are fitted where required. The works are electrically-driven throughout, and every method of drive is in use, the object being to demonstrate the special advantages of this system.

Figs. 1 and 2 are views of the machine shop. Wherever possible tools have been specially designed with a view of machining one class of article. Amongst these may be mentioned boring machines—boring mills, spindle, pulley and capstan lathes, armature notch punching machines, &c., and a noteworthy feature of this department is that by the system of gauges, templates, &c., the use of rule and callipers is rendered unnecessary. On the right of fig. 2 a row of boring machines is shown, which have been fitted with special chucks, &c., thus ensuring accurate and rapid production.

Fig. 3 is a view of the armature and commutator building and brass finishing benches, and fig. 4 is the portion of the winding room set apart for the winding, taping, &c., of armature and magnet coils. A special feature of this department is the winding machines which have been designed and made by the company. This department is worked entirely by girls, and is quite separated from the machine shop.

Fig. 5 is a portion of the tool room. There is here an arrangement of portable shelves, each shelf containing the gauges and special tools required for any given part of a motor. At the commencement of a job these are sent into the works along with the castings. If one of these tools requires renewal, it is brought to the tool room and another tool substituted for it, thus doing away with loss of time and making this department responsible for the maintenance. This method necessitates duplicate sets of tools being kept.

Fig. 6 is a view of the finished mechanical stores. By an arrangement of maximum and minimum stock, this department governs the machine shops, and every individual part of the motors is stacked in large quantities.

Fig. 7 is a view of finished electrical stores which is worked on the same principle.

Fig. 8 is a view of the assembling shop. In designing the motor, special attention was given to having as many machined parts as possible, thus reducing the cost of fitting to a minimum. In this and other views, portable cranes will be noticed. Owing to the light character of the work manufactured, this is the only method of lifting and carrying required, with the exception of a push car track which is fitted throughout the works, and extends to the casting store.

The test plate has been laid down at considerable expense, and an arrangement is made by which the motors drive the dynamos that supply them with current. By this means 80 H.P. can be tested with an expenditure of 15 H.P. from the works plant. The company is in a position to deliver any reasonable number of motors practically from stock. To do this it is necessary to keep a quantity of motors finished mechanically. By this means, with the stock of finished armatures and magnet coils shown in fig. 7, it is an easy matter to deliver a motor of any voltage in 3 to 4 days from receipt of order. Quite recently an order for 20 motors was executed in 16 days, and a further one of 12 motors in 10 days.

At present the company is only manufacturing continuous

Fig. 4.—Part of the Winding Room.

current motors. These are of two types, viz., perfectly enclosed and open protected. The present sizes range from ½ to 15 H.P., but patterns are in hand for 20 and 25 H.P. sizes, it being the company's intention to confine manufacturing to these sizes. The works have been arranged for manufacturing about 40 motors per week, but can easily be

enlarged as the demand may require. The directors are all Manchester men, are intimately connected with the engineering trade, and have had considerable experience in the manufacture of similar classes of work. The works were designed by Mr. Joseph Nodal, architect and engineer, Manchester.

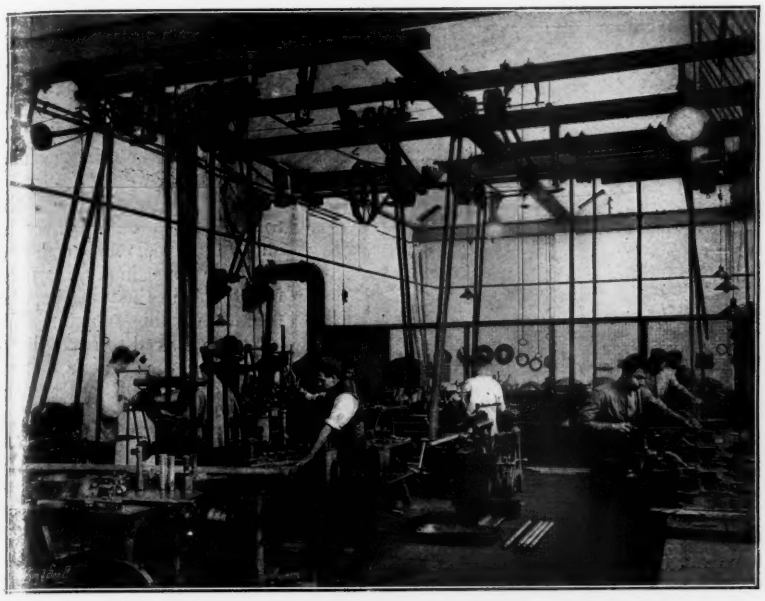


Fig. 5.—Tool Room.

The consulting electrical engineer is Mr. Claude W. Atkinson, and the arrangement and organisation of the works has been carried out by Mr. Ben. Longbottom, to whom, and the secretary, Mr. T. M. Gribbin, we are indebted for the foregoing particulars.

It will scarcely be credited that an impression exists in certain quarters that Electromotors, Limited, receive parts of motors from the States and fit them up here; in other words, the *bona fides* of the company as manufacturers of its own motors has been questioned.

It seems hardly necessary to say that such an impression is wholly an erroneous one, and that the motors are English made from beginning to end. It is also significant that a large Anglo-American concern, situated not a hundred miles from Openshaw, has found it convenient to purchase motors of the company because, when time is an object, they can be delivered more quickly than by ordering from America.

Mr. Longbottom has a keen appreciation of the value of labour-saving tools, and his powers of organisation struck us as being of a very high order. He is young and full of enthusiasm, and we feel convinced that Electromotors, Limited, has entered upon a distinctly successful career. The London offices of the company are at 35, Queen Victoria Street, and the representative, Mr. G. H. Congdon.

Electromotors, Limited: Fig. 6.—Store Room for Finished Mechanical Parts.

REVIEWS.

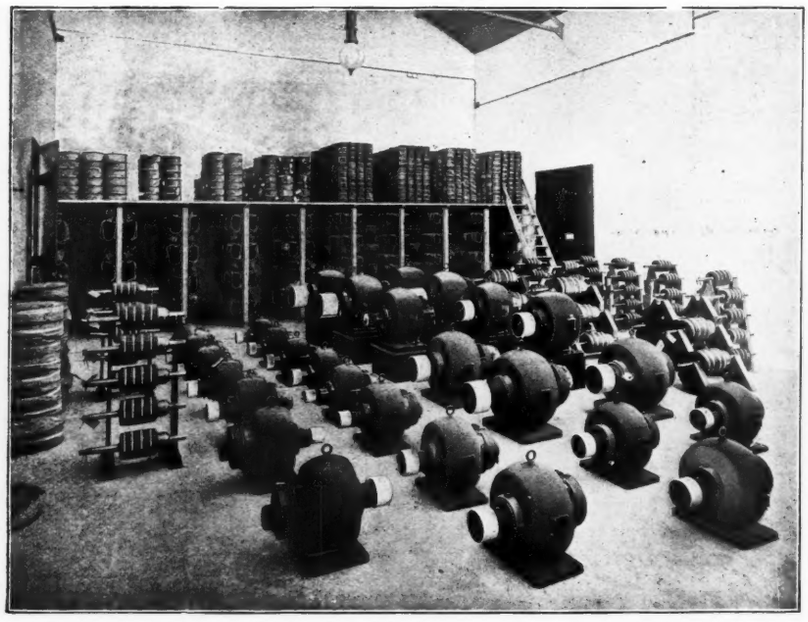
Logarithms. By F. G. Taylor, M.A., B.Sc. London: Longmans, Green & Co. 1901. Price 1s. 6d.

The object of the author of this work is to provide a simple introduction to the use of logarithms, so as to bring them within the reach of elementary students in technical schools, and at the same time to provide more advanced students with a useful hand-book.

There are three tables of logs., each arranged in a single opening; they run to four figures (the fourth being obtained by interpolation), and are respectively logarithms, logs. of reciprocals, and anti-logarithms. Thus the actual tables are confined to six pages, while 40 pages are devoted to explanations and examples of their use. The first chapter is devoted to arithmetical principles, which are concisely and clearly stated. The second chapter deals with approximate calculation—a subject of great importance to the practical man, but too often utterly ignored in the schools. How many students understand the meaning of "significant figures?" When they have been taught to work out sums to so many "decimal places," they naturally confuse the latter with the former, and evolve long strings of meaningless figures, where three or four figures and a few ciphers would suffice. The importance of checking calculations made with logarithms, by means of rough approximate arithmetical calculations, can only be fully realised by those who have erred, and suffered through the lack of this precaution; the author emphasises this, and shows how such verifications may be quickly carried out. We should have liked to see the short methods of multiplication and division included in this chapter; but in practice there is nothing better than the slide rule for verifying logarithmic calculations to the first three significant figures. Chapters III. to VII. consist of explanations of the methods of finding the logarithms of numbers in the tables, and using them in calculations. The methods given include calculations with the logs of reciprocals, which are apt, we fear, to cause confusion in the mind of the beginner; it would perhaps have been better to omit these, especially as they are not in common use. Chapter VIII. gives examples in mensuration, worked out by logs. Numerous exercises are given for practice; the index law and the method of

conversion from common to hyperbolic logs are given in appendices, and the book concludes with answers to the exercises.

As we have stated above, this is essentially a book for learners, and as such it is well planned and of considerable merit.



Electromotors, Limited.—Fig. 7.—Store Room of Electrical Parts.

Weights of Steel Bars and Sheets, &c. Compiled and Published by F. Barker. Sheffield. Price 1s.

This little book gives the weights of square, round, octagon, hexagon, three-square and flat bars, oval bars and sheets, from the smallest sections up to the largest in ordinary use, arranged in tabular form for ready reference. A number of tables of weights and measures are given at the end of the book. There is no superfluous matter, and the book should be of considerable use as a time-saver.

Wireless Telegraphy: A Popular Exposition. By G. W. de Tunzelmann, B.Sc. London: The Office of *Knowledge*, 326, High Holborn. 1901.

This work, though extending only to some hundred pages, and stated to be a popular exposition, is much more ambitious, or, rather, what the Germans would call *eingehend*, than we have hitherto been accustomed to in books on this subject. After a chapter on the earth current systems of wireless telegraphy, we have a chapter which attempts to give us a popular explanation of the most recent and abstruse mathematical theories of the ether. In our opinion, the attempt is, to a great extent, a failure, not so much on account of any want of ability in the author, but because the subject is too abstruse to be brought down to the level of the popular understanding. That such attempts may give altogether erroneous and incorrect impressions to the popular reader unless the greatest care is exercised, is illustrated by the following extract from p. 33 of this work: "The development of electrical theory has for a long time been tending towards the recognition of an atomic distribution of electricity, so much so, that Maxwell even made use of the expression, 'an atom of electricity.' He and von Helmholtz have both pointed out that Faraday's quantitative laws of electrolysis necessarily lead to this conclusion, and *that each atom of matter has its definite electric equivalent, which is the same for every kind of atom.*" How this statement can be reconciled with Helmholtz's law, which asserts that eachunit of valency (not each atom) is charged with the same quantity of electricity, we fail to see.

The explanation of the nature of the ether waves is, on the whole, very good, and contains some important facts not found in the usual popular treatises on this subject. We are not prepared to agree, however, with the author's dictum that oscillations of great wave length must be used in wireless telegraphy to enable them to penetrate through land and water. The fact that wireless telegraphy to long distances has been most successful at sea, and least successful in mountainous countries, lends strong support to Blochmann's theory that the electric waves used in wireless telegraphy never pass through land and water, but flow along equipotential surfaces in the atmosphere. The author, as a consequence of his belief in the necessity of long waves, considers that the only function of a long vertical conductor is to produce long waves. Slaby has shown that the longer the conductor, the greater is the amplitude of the disturbances produced, and this, in our opinion, gives a much more satisfactory explanation of its function in long distance wireless telegraphy.

Electromotors, Limited.—Fig. 8.—Assembling Shop.

This little work gives a very good account of the principal steps in the development of wireless telegraphy, and is quite up to date, giving an account of Marconi's paper read at the Society of Arts last June, and the more recent experiments of

the United States Weather Bureau, whose promise has not as yet been justified by public performance; Mr. Marconi still keeping far ahead of all his rivals for long distance.

The author discusses the rival theories of the coherer, but though commending Dr. Chunder Bose's views, he thinks that the welding action favoured by Dr. Lodge also plays a part.

We can recommend the book to those who wish to get a good grasp of the theory of wireless telegraphy—or at least as good a grasp as can be got without the necessary mathematical equipment.

The Application of Electric Motors to Machine Driving. By Andrew Stewart, A.I.E.E. London: S. Rentell & Co., Limited. 1900. Price 1s.

This is a reprint of a series of articles which appeared in *Electricity*, and deals with the chief advantages and leading features of the local application of power in works. To this end, figures are given showing the losses incurred with shafting and scattered steam plants. The author points out, however, that shafting cannot economically be entirely dispensed with, owing to the high price and low efficiency of very small motors.

The conditions to be fulfilled by the motors, and the manner in which they are complied with, are indicated with the aid of curves; the application of electricity to the driving of cranes, and its incidental advantages, such as the use of electro-magnets for lifting masses of iron and steel, receive special attention. The author shows a strong preference for three-motor crane equipments. Printing machinery is also dealt with at some length, and a comparison is instituted between small separate motors and a large motor with shafting, the conclusion being reached that it is generally undesirable to use a countershaft where more than 3 or 4 H.P. are required for each machine.

The author condemns the crude and wasteful methods of driving and heating often used in textile factories, for which absolutely watertight motors are recommended; it does not appear, however, that electricity has made much actual headway in this connection.

The author goes rather out of his way to explain the nature of polyphase currents, gets into a muddle, and drops the subject abruptly. Speaking of enclosed motors, he states that they must be at least 15 per cent. larger than open motors for the same power; this is a very conservative allowance.

The usual methods of speed control are fairly well stated, though the subject of controllers, in which are met the principal difficulties in electric driving, is treated in a very superficial manner. The book concludes with general remarks on speed variation, carbon brushes, low speed motors, &c.

Although the phraseology of the author is not always above criticism, the substance of the book is, on the whole, of a practical and useful nature, and it ought especially to be of interest to those who, while not deeply versed in electrical matters, are desirous of obtaining such information on the subject of electrical driving as will enable them to decide on the question of applying it to their factories and workshops.

ELECTRIC TRACTION NOTES.

(*Continued from page* 674.)

Nottingham.—The Trent Bridge and Station Street sections of the electric tramways are now open for traffic.

Underground Railways.—There is an underground electric railway scheme projected from Waltham Abbey to the Royal Exchange For the most part it would be 100 ft. below the surface, and the cost is put down at about £2,000,000.

The *Standard* understands that a combination of interests has been arranged between the Brompton and Piccadilly and Great Northern and Strand Electric "Tube" Railways under which a through line will be made from the northern suburbs of London to South Kensington, connecting the systems of the Great Northern and the Metropolitan District Railway Companies. The scheme is contingent upon Parliamentary powers being obtained for a link line to run under Shaftesbury Avenue from Piccadilly Circus to High Holborn; but no difficulty as to this is anticipated, as the Joint Parliamentary Committee of last session recommended the extension of the Brompton and Piccadilly line in a northerly direction. The present scheme has been arranged through the agency of Mr. C. T. Yerkes. The new through line now proposed will have an exchange station with the Charing Cross line at the Oxford Street end of Tottenham Court Road. There will also be an exchange station at Piccadilly Circus with the Baker Street and Waterloo line (now under construction), and another with the Central London at Holborn. Arrangements have been made for the Brompton and Piccadilly section to be commenced forthwith, Messrs. Walker, Price & Reeves, of Westminster, having undertaken the contract.

Underground electric "tube" railways have been suggested for Birmingham, but in some quarters the question is raised as to whether it is necessary to consider such an idea before the tramway service has been put into something like order. Until electric traction is used throughout the entire Birmingham system, and reasonable extensions are taken in hand, it is not likely that the city will be adequately equipped to cope with the heavy traffic.

Walthamstow.—The U.D.C.'s electric tram scheme, for which powers are being sought, provides for a system extending from Tottenham High Cross to Chingford, and from Lea Bridge Road to Woodford, at a cost of £120,000.

TELEGRAPH AND TELEPHONE NOTES.

The Postmaster-General and the Telegraphists.—The following is a copy of the last letter from the Postmaster-General to the men's deputation:—

I am directed by the P.M.G. to communicate the following reply to the deputation who waited on his Lordship on July 9th last, on the subject of the £190 maximum.

The P.M.G. has carefully considered the representations made to him on July 9th last, by Messrs. Davis, Garland and Belderson in support of the claims of the general body of telegraphists in the C.T.O. to rise to a maximum of £190 per annum, and of the allegation that the Department had committed a breach of faith with the staff on this point. In consenting to receive the deputation, the P.M.G. explained the view which he himself took of the question at issue, and added that unless any new facts of which he was unaware could be brought forward he saw no likelihood of coming to any other conclusion.

After hearing the representations of the three gentlemen who attended, the P.M.G. is constrained to say that his opinion remains unaltered, much of what was urged by the deputation had no direct bearing upon the question to which the discussion was intended to be confined, namely, whether the "prospect of attaining £190" which was held out to candidates entering the service between 1881 and 1889 had been withdrawn or modified by the Department.

In the reply given to Mr. Garland by the Controller of the C.T.O on June 27th last, the P.M.G. had already expressed himself on this point as follow:—"The prospect of attaining £190 is still open to all who entered the service with that inducement before them, and the conditions under which it can be attained do not materially differ from those which prevailed at any time between 1881 and 1889. The class to which the maximum of £190 was attached still exists. Its complement which in 1881 was 120 is now 176. Access is obtained to it in precisely the same way now as then, namely, by the selection of a duly qualified officer to fill any vacancy which may occur." The main argument of the deputation was directed against the view that access could only be gained to the senior class on the occurrence of vacancies. They asserted that during "a period of many years" the Department promoted men into the Senior Class "on reaching the top of the £140 scale, without having to wait for dead men's shoes to step into," and they urged that promotion should now as then ensue upon a man reaching the top of the scale provided he can qualify as to good character and manipulative ability of the highest sort, or in other words, that the Senior Class should be unlimited in numbers. In reply to these contentions the P.M.G. can only say that the question at issue is one of fact, and that the deputation are under a misapprehension. The Senior Class, like the other classes, is, and always has been, strictly limited in numbers, no promotion was ever made to it except on the occurrence of a vacancy, and promotion did not ensue as a matter of course on reaching the top of the class below.

For example, in the year 1881, 20 officers were promoted to the Senior Class. Three of them had been at the maximum of the lower class more than three years, seven for one year and eight months, one for 11 months, and two had not reached the maximum at all. In the year 1882, eight officers reached the maximum, but no promotions were made. In the year 1883, 12 other officers reached the maximum and only three promotions were made. Further illustrations of the same character would be found on examining the promotions in subsequent years, but the P.M.G. thinks that the above are sufficient to show that the statements made by the deputation are inaccurate. The remaining arguments put forward at the interview relate chiefly to the interpretation placed by the staff on the words of the notice issued by the Civil Service Commissioners to intending candidates, and the inferences which may properly be drawn from it. The P.M.G. can only say that he is unable to agree with the deputation.

He does not think that the words of the notice justified any candidate in supposing that he would necessarily attain a salary of £190 without waiting for vacancies in the classes above that in which he entered. Such an interpretation would indeed imply that a prospect of attaining £190 was equivalent to "a certainty of attaining £190;" classification in one form or another prevails throughout the Civil Service of the State, and the fact that a civil servant has to depend on vacancies for promotion is notorious. If any candidate did enter the service under a misapprehension on this point, he could hardly have failed to realise his mistake at a very early period, for he would have found the staff divided into classes with limited numbers in each, and he could have easily ascertained that no officer was promoted from one class to another unless there was a vacancy. The fact that in a growing service promotion came more rapidly at one period than another could not, of course, affect the condition that the number in each class was limited, and that no promotion could be made without a vacancy.

(Signed) E. May.
Controller C.T.O.

Durban Telephones.—At a recent meeting of the Town Council a proposal was submitted for the purchase of the Telephone Company's business on a valuation taken at the present time.

Liverpool—Paris Telegrams.—Direct telegraphic communication has just been established between Liverpool and Paris.

Telegraphs and Telephones at Peru.—The Belgian Consulate at Lima, states that the Peruvian Government proposes to extend the National telegraphic and telephonic system. Orders are to be placed at an early date for iron poles, bronze wire for telephone and telegraph, and cables for aerial railways. It is advisable for manufacturers to deal through an agent on the spot.

British Telegraphs in Persia.—In view of the political importance of British control of the Indo-European telegraphs in Persia, it is worthy of note, says the *Times*, that the announcement of the Shah's signature of an agreement with the British Government for a three-wire telegraph line to be constructed from Kashan to the Baluchistan frontier is semi-officially confirmed at Simla. The line is to run *via* Kirman and Bampur to Jask, the point on the Baluchistan coast where the land line from Karachi is continued by cable up the Persian Gulf. Its main purpose is to make the Indo-European system independent of this cable, which is frequently breached, but it will also serve to facilitate communication with South-Eastern Persia, whence news travels very slowly.

Collapse of the London—Brussels Telephone Cable.—In a special telegram from Brussels to the *Pall Mall Gazette* we read the following:—"The inauguration of the London—Brussels telephone will have to be deferred owing to an accident. The laying of the cable had actually begun, and had proceeded for a considerable distance when the working party made certain tests which caused so much damage that a new cable will be necessary."—This imputes blame to the "working party," which we can hardly believe to be deserved.

Rochester Telephones. — The local authorities of Rochester, Gillingham and Chatham are to confer on the subject of municipal telephones.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Bissao-Bolama	Aug. 16, 1901 ..	October 22.
Cayenne-Pinheiro	Oct. 15, 1901 ..	..
Cap St. Jaques-Thuanan Haiphong ..	Oct. 17, 1901 ..	..
Landlines:—		
"*Via* Hanekin" on Persian territory ..	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
" towns of Venezuela ..	Oct. 31, 1900 ..	..
Blagowestschenk-Khabarowsk	Oct. 15, 1901 ..	..

The Telephone Service. — The daily press prints important correspondence which has passed between the National Telephone Company and the Association of Chambers of Commerce as to the allegations of the Postmaster-General that the delays in the telephone service have been caused by the inadequacy of the National Telephone Company's junction system. The secretary of Telephone Co. says:—"The duty rests with the Postmaster-General to connect up towns with the trunk telephone system, but in nearly all cases he only brings his trunk wires to one town in an area, and *ex gratia* the company has distributed his trunk messages to the other towns therein." Mr. Murray replies on behalf of the Postmaster-General that he has recently called the attention of the Telephone Company to the unnecessary delay due to the want of additional junction wires with the trunk wire system. "In many towns additional trunk wires have been provided within the last two years without a corresponding addition to the number of the company's junction wires, so that the number of the junction wires is now less than the number of trunk wires, and, as during the busiest hours of the day the trunk wires are occupied by a constant succession of calls, it is evident that delay must frequently take place because junction wires are not available for the extension of the trunk wires to the offices of subscribers. Under the agreement of March 25th, 1896, between the National Telephone Company and the Post Office, the company bound themselves to provide, if necessary, two junction wires for every trunk wire led into a post-office, but it has been the practice hitherto not to require more than one junction wire for each trunk wire, and for some time past the company have failed to comply with this very moderate requirement, with the result that delay in working has been caused unnecessarily. Under the agreements made with their subscribers, the company have in the ordinary course guaranteed to subscribers to all exchanges, in return for their subscriptions, the right of access to the trunk wire system, and, as no other means of securing this right to the subscribers of outlying exchanges except the company's junction wires has hitherto existed, the repudiation in the general manager's letter of any obligation on the company to provide junction wires for the purpose, seems to the Postmaster-General to indicate a new view of the responsibilities of the company both to the Post Office and to their subscribers."

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam. — November 18th. Electrical overhead construction, rail bonds, &c, for the City Council. See "Official Notices" October 18th.

Ashton-under-Lyne.—October 29th. Steel poles, bases, section boxes, and overhead line equipment for the Corporation. See "Official Notices" October 11th.

Army Contracts.—The Secretary of State for War gives notice that tenders for specific quantities of the undermentioned articles will probably be invited from time to time during the next 12 months, namely:—Acids, Electrical Instruments, Telegraph Cable. See "Official Notices" October 18th.

Barking Town. — November 12th. An electrically-driven loco. crane, and permanent way for the U.D.C. See "Official Notices" October 18th.

Boulder City.—November 23rd. The Council invites tenders from manufacturers for the construction of a tramway system, plans and specifications of which are to be seen at the office of the Agent-General, London. See "Official Notices" September 20th.

Bury.—November 18th. 28 electric tramcars for the Tramways Committee. Lacey, Clirehugh & Sillar, engineers.

Christiania.—October 30th. Telegraph materials for the Norwegian State Railways Department. Particulars may be examined at the Commercial Department of the Foreign Office.

Dudley.—October 25th. Pipework for electricity works. See "Official Notices" October 11th.

East Ham.—October 28th. Electric lighting fittings for the pupil teacher's centre and School Board office. Specification from H. C. Padgett, clerk, School Board office, East Ham.

East London (S.A.).—November 26th. Tenders to Mr. R. N. Moir, Town Clerk, for 50-kw alternator and engine. London agents, Dyer & Dyer, Aldermanbury, E.C.

Ilford.—October 29th. Water-tube boiler, 550-kw. high speed steam dynamo, switchboard, &c., for U.D.C. tramways. See "Official Notices" October 11th.

Lancaster.—The Tramways Committee are advertising for tenders for:—

(*a*) Supply of rails, fish plates, bonds, &c.
(*b*) Laying the above.
(*c*) Supply and fixing of poles and overhead equipment.
(*d*) Supply of feeder cables and pilot wires.
(*e*) Cars.

L.C.C.—October 31st. Electric lighting of the Homerton, West Hampstead, East Greenwich, and Perry-Vale fire stations. See "Official Notices" October 11th.

Leyton.—October 26th. Multipolar dynamo (450-kw.) and a balancer, for the U.D.C. See "Official Notices" October 11th.

Limerick.—October 28th. Cables, arc lamps, Westinghouse engines, dynamos, boosters, and Dowson gas plant for the electric lighting. See "Official Notices" October 11th.

Manchester.—November 9th. Telescopic and rigid tower wagons for the Tramways Committee. See "Official Notices" to-day.

Manchester.—October 30th. Electricity Committee of the Manchester Corporation are prepared to receive tenders for supply, delivery, and erection of 11 overhead travelling hand cranes in 10 sub-sections.

Manchester.—Two 6,000-h.p. triple-expansion engines, two 3,750-kw., three-phase alternators, 48 motor-generators for Stuart Street generating station, and sub-stations. See "Official Notices" October 11th.

Oldham.—November 5th. Cables, joint boxes, motor booster, motor-generators, switchgear, &c., for the electricity works. See "Official Notices" October 18th.

Rochdale.—November 8th. Boilers, economisers, stokers, condensers, &c., for the electricity works. See "Official Notices" October 18th.

Spain.—October 28th. The municipal authorities of Jaca (province of Huesca) are inviting tenders until the 28th inst. for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Jaca (Huesca).

Spain.—November 4th. Tenders are being invited until November 4th by the municipal authorities of Burgo de Osma (province of Soria) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to El Secretario del Ayuntamiento de Burgo de Osma (Soria), whence particulars may be obtained.

Spain.—November 15th. Tenders are being invited until November 15th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system in the town of Valdepeñas (province of Ciudad Real). Particulars can be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Madrid.

South Lancashire.—November 4th. High and low tension cables, stoneware pipes, &c., for the South Lancashire Electric Traction and Power Company. See "Official Notices" October 18th.

South Lancashire.—November 25th. Overhead electrical equipment of lines for the S. L. E. T. and Power Company. See "Official Notices" to-day.

Swadlincote. — October 30th. The U.D.C. wants tenders for extending electric lighting to New Stanton. Mr. T. Kidd, engineer and surveyor.

Swindon.—November 12th. Boilers, cooling tower, 10-ton crane and other plant for electricity works. See "Official Notices" October 11th.

Willesden.—November 12th. Boilers, steam dynamos, transformers, motor-generators, switch-gear, cranes, battery, mains, public lamps, piping, condensing plant, &c., for the D.C. electricity works scheme. See "Official Notices" to-day.

CLOSED.

Croydon.—The County Council have accepted the tender of Messrs. Wenham & Water for £2,779 for the electric lighting of the new Borough Lunatic Asylum. 26 tenders were received for the work, the lowest being £2,185, and the highest £6,936, the engineer's estimate being £3,468.

Doncaster.—The Corporation has placed an order with Messrs. D. Bruce Peebles & Co. for the supply of one 300-E.H.P. generator, spares, &c., for the sum of £3,289.

Leeds.—A sub-committee of the Tramways Committee has recommended the acceptance of the tender of the British Thomson-Houston Company for 50 electric cars, subject to the firm agreeing to the Committee's specifications. The amount of the tender is nearly £26,000.

L.C.C.—The Council has contracted with Messrs. Benham and Sons for the electric light installation (£6,252) at the epileptic colony; and with Messrs. Babcock & Wilcox for boilers, &c. (£1,170).

Manchester.—We learn that Messrs. Isaac Bentley and Company, of Salford, have received the contract for the supply of axle lubricant for the Corporation electric tramcars. The firm makes a speciality of the "Borallis" lubricants for car motors and axles.

Manchester.—The Electricity Committee on Thursday last week accepted the tender of Messrs. W. T. Glover & Co., Limited, Trafford Park, for the supply, delivery, and laying of three-phase mains, telephone mains, arc lighting cables and other cables for electricity purposes. The length of the cables is 147 miles, and the amount of the tender is over £130,000. The firm undertake the work of laying within six months of the order being given, and although theirs was not the lowest tender, their promise of delivery was most satisfactory. The work would have been undertaken by the Corporation but for the urgency of the matter. Without the completion of the order within six months it will be impossible for the Electricity Committee to fulfil its obligations by enabling the Tramways Committee to open new electrical routes in May next year. The bulk of the cables will be used in connecting the sub-stations with the new generating station in Stuart Street, and the contract relates to lighting and traction also.

FORTHCOMING EVENTS.

Friday, October 25th.—At 5 p.m. Physical Society; meeting at the rooms of the Chemical Society, Burlington House. Paper "On the Variation with Temperature of the Thermo-electromotive Force and of the Electric Resistance of Nickel, Iron and Copper, between the Temperatures of −200° and +1,050°," by Mr. E. P. Harrison.

At 8 p.m. Institution of Junior Engineers; annual general meeting at the Westminster Palace Hotel, for the presentation of the report of the Council and election of officers for twenty-first session.

Thursday, October 31st.—At 8.30 p.m. Chemical Society. Meeting at Burlington House, Piccadilly. The Frankland Memorial Lecture, by Prof. H. E. Armstrong.

Friday, November 1st.—At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Chair will be taken by the retiring president, Sir Lowthian Bell, Bart., F.R.S., succeeded by Sir John Jackson, F.R.S.E., who will deliver his presidential address.

At 8 p.m.—Institution of Mechanical Engineers. Adjourned discussion on the 2nd Gas Engine Research Report by Prof. Frederick W. Burstall.

Saturday, November 2nd.—Electrical Volunteers' smoking concert. (See "Notes.")

Thursday, November 7th.—At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at St. Ermin's Hotel, Caxton Street, Westminster. Paper on "Electric Traction," by Mr. B. Pontifex.

Thursday, November 14th.—Meeting of the Dublin Section of the Institution of Electrical Engineers. Paper by Mr. P. S. Sheardown on "An Account of the German Tour of the I.E.E."

Thursday, November 21st.—Opening meeting of the Institution of Electrical Engineers.

NOTES.

Pipe and Flange Standards.—A joint committee of valve and fitting makers and various associations has sat in the United States in order to determine a flange and bolt standard for high pressure work, in order to facilitate general business and make it safe to keep stocks of ready-drilled material. The following were its recommendations:—(1) The number of bolts must be four or multiples of four, thus abolishing the six-bolt flange. (2) No bolt should lie on the vertical axis, which should lie evenly between two holes. This again is good practice and accords with generally accepted ideas on this side. (3) Bolt pitches should not exceed 3⅝ in., except on the 2½ size, which cannot have eight bolts very well, and we may almost regret the six-bolt flange for this particular size. It appears that the committee did try to put eight ⅝-in. bolts into this 2½ flange, but they appeared impracticable, so that four ¾-in. bolts were adopted for this one size. We might add that eight ½-in. bolts could possibly be worked in, but our own experience is altogether against the use of ½-in. bolts, which lose so much strength in threading, and are below what practical engineering deems advisable. No doubt a ½-in. bolt perfectly made is all right, but experience has shown us that ½-in. bolts always suffer in the making, and should not be employed for important fastenings. (4) From bolt centre to edge of flange should be ⅛ in. more than bolt diameter up to 9-in. sizes of pipe, and plus ¼ in. above 9 in. The annexed table, for which we are indebted to the *Engineer*, shows the selected standards, and may be obtained from the committee's secretary, Mr. J. F. O'Brien, P.O. Drawer 66, Station A., Hartford, Conn., U.S.A. We think these proportions will be found fairly consistent with good practice, but it is a matter of regret that a standard was not fixed by manufacturers in Committee from both sides of the Atlantic, as well as a uniform thread for steel or wrought-iron pipe, the American threads for which are at present badly proportioned and call for excessive pipe thickness, and also make bad joints.

Size of pipe.	Diameter of flange.	Thickness of flange.	Diameter of bolt circle.	Number of bolts.	Size of bolts.
In.	In.	In.	In.		In.
2	6½	⅞	5	4	⅝
2½	7½	1	5⅞	4	¾
3	8¼	1⅛	6⅝	8	⅝
3½	9	1 3/16	7¼	8	⅝
4	10	1¼	7⅞	8	¾
4½	10½	1 5/16	8⅜	8	¾
5	11	1⅜	9¼	8	¾
6	12½	1 7/16	10⅝	12	¾
7	14	1½	11⅞	12	⅞
8	15	1⅝	13	12	⅞
9	16	1¾	14	12	1
10	17½	1⅞	15¼	16	1
12	20	2	17¾	16	1⅛
14	22½	2⅛	20	20	1⅛
15	23½	2 3/16	21	20	1
16	25	2¼	22½	20	1
18	27	2⅜	24½	24	1
20	29½	2½	26¾	24	1⅛
22	31½	2⅝	28¾	28	1⅛
24	34	2¾	31¼	28	1⅛

Glasgow Exhibition.—The Executive have decided to issue diplomas of merit only to exhibitors, so that the idea of medals is abandoned. The exhibition is to close on Saturday, November 9th. Attendance to October 15th, 9,400,000; drawings, £138,122 19s. The 1,000 arc lamps were loaned to the Glasgow Exhibition at 35s. each for 600 hours' use with an additional charge of 6d. per lamp hour if used beyond that time. This price included delivery on site but not erection, and the exhibition authorities were to undertake the removal of the lamps from the buildings, and careful packing for return to the makers at the end of the exhibition. The above prices include carbons.

Boiler Covering Tests.—We have received from Messrs. A. Haacke & Co. a copy of some tests made for them by the National Boiler Insurance Company on a steam pipe at the generating station of the Isle of Thanet Electric Tramways. The tests were carried out on pipes in which full steam pressure was maintained, but there was no flow of steam. The conditions with pipes bare and covered were otherwise practically identical. It appears that 712 sq. ft. of exposed pipe containing steam at 364·2° F. and with an outside temperature of 59° F., condensed 731 lbs. of steam per hour, or fully 1 lb. per sq. ft. per hour. An area of 420 sq. ft. was then covered with fossil meal 1⅛ in. to 2 in. thick, after which steam at 366·65° F. condensed at the rate of only 345 lb. per hour. Calculating out results it would appear that while the bare pipe condenses 1·026 lb. per sq. ft. the covered pipe only condenses 0·108 lb. The waste is reduced nearly tenfold. The outside temperature, it is true, was 69° F. during the covered tests, but this is a comparative trifle. Importance is attributed, and very rightly, to covering flanges. It is usual to stop the covering 1 in. short of a flange. This is good practice, but, all the same, flanges should have at least the protection of a hinged removable box, as they are, like gilled pipes, most effective coolers. Put into another form, the tests show about 380 tons of coal per annum for the pipes bare and only 46 tons if wholly covered. Our calculation makes out a rather more favourable case for covering than is given in the report before

us because we have neglected the difference of atmospheric temperatures. The figures given in the report show 2·88 heat units per sq. ft. per hour per degree of temperature difference with pipes bare and only 0·348 unit with pipe covered, or a ratio of 8·3, which is less favourable than the ratio of nearly 10 arrived at where temperature was neglected. Coverings to steam pipes undoubtedly pay for themselves.

Glasgow and West of Scotland Technical College.—Mr. C. P. Hogg, M.I.C.E., delivered his presidential address to the Glasgow Technical College Scientific Society on Saturday last. He covered a very wide field of engineering matters in the course of his remarks, and dwelt upon the backward effect of legislation upon the electric lighting and tramway industries. His general formula for success in applied science was sound and sufficient knowledge of mathematics, plus best technical education, plus wise legislation. The following are some of the arrangements for the present session:—

November 2nd.—"Electricity Works Load Factors," by J. Gray Scott, A.M.I.E.E., Leith.
November 16th.—"High-power Gas Engines and Conditions Necessary for their Successful Working," by A. Rollason, Nottingham.
November 30th.—"The General Arrangement of Power Stations," by A. H. Morton, A.M.Inst.C.E.
December 14th.—"Limit Gauge System of Shop Work," by W. H. Booth, London.
January 11th, 1902.—"A Coal-burning Internal-combustion Engine," by P. F. Maccallum.
January 18th.—"Manchester and Liverpool High-speed Electrical Railway," by F. B. Behr, London.
January 25th.—"Large Storage Batteries and their Application to Central Station Supply," by Henry MacEwen, Wh.Sc.
February 8th.—"Rotating Magnetic Fields," by Prof. Magnus MacLean, M.A., D.Sc.
February 15th.—Tenth anniversary dinner.
March 8th.—"The Design of Conductors for Electric Railways," by Frank B. Lea, B.A.
March 22nd.—"Water Turbines," by John M'Donald.
April 5th.—Annual general meeting.

The Milan—Varese Electric Railway.—The Rome correspondent of the *Morning Post* reports that, after several months of experiments and trial trips, the electric railway between Milan and Varese has been opened to the public. The railway, which is 90 kilometres (about 46 miles) in length, is the first line in Italy to be built on the "third rail system." It consists of a double line of ordinary rails, between which runs a single conductor rail raised about a foot from the ground on earthenware insulators. The cars, which are about 40 ft. long, are not unlike those of the Central London Railway, though they are somewhat more spacious. Each car is furnished with four projecting arms, at the end of which is a steel brush in contact with the conductor rail. On the journeys from Milan to Varese, the arms to the right of the cars are in contact with the rail, and on the downward journey the left arms are in contact. At the level crossings the conductor passes underground, but as none of the crossings are 40 ft. wide, the car remains in constant touch with the rail by means of its fore or aft arm. Under the car is placed an electric motor, and each car is furnished with an electric air pump for the Westinghouse brake and the whistle. The current is furnished from a station on the banks of the Ticino, where it can be generated either by water or by steam power, as the railway company has duplicate plant in case of a breakdown. Both plants dispose of 11,000 H.P. The current is conveyed from the generating station to the third rail by an elevated cable. Each car conveys 73 persons, and covers the distance from Milan to Varese in an hour. Departure takes place from Milan and Varese every 15 minutes.

How New York is to Deal with its Vast Traffic.—New York City not only contains the most complex problem in transportation, but is also the scene of the greatest activity in electric railway construction in the world. This is due partly to the configuration of the city and its relations to the water channels which surround it. Manhattan Borough, which contains the most important business districts and most densely inhabited portions of the greater city, is situated on a long and narrow island, and is connected by only one bridge to the next most populous borough, Brooklyn, often called the dormitory of New York. These conditions make the number of rides *per capita* on the different transportation systems within the city reach between 350 and 400 annually, a figure largely in excess of that in any other city. The other principal reason which makes the New York traffic situation of particular interest at the present time is that, owing to local circumstances, the introduction by the companies in the city of modern traction methods has been until recently very much delayed, so that the improvements now being made are more extensive than they otherwise would be, because they represent the accumulation of years of comparative inactivity. Thus the metropolitan railways, being prohibited from using the trolley, have installed the conduit system so recently that the company's power station is entirely modern in its equipment, and represents not only the latest engineering practice, but what may be fairly considered as an advance on present practice, inasmuch as it is still the pioneer in the distribution of large currents for railways at high potential. The elevated railway system is also now in process of transformation to electric power, and the work is so far advanced that the power station building is completely erected, part of the machinery is installed, and all the rolling stock is under contract. In addition, the Rapid Transit Subway, so long discussed and the subject of so much contention, has now been in the hands of the contractor for about a year and a half, and most of the excavation has been completed. It is eminently true, therefore, to say that the eyes of the world, so far as transportation is concerned, are on New York City, because it presents not only the largest and most complicated urban traffic problems in existence, but also the most advanced steps made to solve them by modern transportation methods.—*Street Railway Journal.*

The Alleged Corruption at West Ham.—At Tuesday's meeting of the Council a long debate ensued on allegations of corruption suggested against certain members of the Corporation in connection with electric lighting contracts. It was decided "that arrangements be made at once for a public impartial and judicial inquiry into the charges made against certain members of this Council with reference to electric lighting and other contracts; that Mr. Ernest Baggallay be invited to adjudicate; and that members of the Council making allegations should put into writing their definite charges." Our readers will remember the similar inquiry held in April, 1896, by Mr. Baggallay.

Electricity Supply Works and London Fogs.—The Meteorological Office has arranged, in conjunction with the London County Council, to hold an inquiry into the occurrence and distribution of fogs in the London district, and their relation to other atmospheric and local conditions. This decision has been brought about by applications from metropolitan electric supply companies and one local authority supplying electricity for special forecasts or warnings of the approach of fogs.

Electromobile Run.—A new long-distance record for electric motor cars was made by M. Krieger on the Paris-Chatellerault road last week. Some time ago M. Garcin succeeded in covering a distance of 163 miles on one charge of the battery. M. Krieger has now gone considerably better than his rival, having managed to travel no less than 192 miles on one charge.

Personal.—The Municipal Trading Committee of the London Chamber of Commerce is organising a complimentary dinner to the Hon. Robert Porter (United States Commissioner), whose views on municipal trading and purity of local administration have attracted some attention both in the United States and in this country. A number of representative men connected with railway, tramway, power and electric lighting undertakings have intimated their intention to be present at the dinner, which will be held on the 31st inst. Applications for tickets should be made to the secretary of the London Chamber of Commerce, 10, Eastcheap, E.C.

On 14th inst. Mr. W. Slade Olver was presented with a handsome silver cigarette box and travelling kit bag by the engineering staff and employés of the Potteries Electric Traction Company, on his resignation of the post of general manager. Mr. Saner made the presentation, saying, "that both the staff and employés desired to show their appreciation of the kindness and consideration Mr. Olver had always shown towards them, and they wished him every success and happiness in his new position." Mr. Olver is leaving the Potteries to take up a position in the London office of the British Electric Traction Company. He has been connected with the Potteries for the last three years as engineer and general manager, during which time the line has grown from 5½ to 29½ miles of route.

The *Review of the River Plate* says that Naval Lieutenant Ballvé has been appointed director of the magnetic surveys to be carried out in the Far South, in concordance with the Antarctic expedition. The *Azopardo* was to be placed at his service.

Mr. B. H. Jenkinson has resigned the position of general manager to Hands, Limited, and communications should in future be addressed to him at 18, Crouch Hall Road, Crouch End, N.

Mr. W. H. Muckley has been appointed assistant superintendent at the Liverpool Corporation car factory at £300 per annum. He was previously works manager to the Lancashire and Yorkshire Railway Company at Horwich.

Last week Mr. H. A. Humphrey, who has been for many years electrical engineer to Messrs. Brunner, Mond & Co., was presented by the directors, staff, and employés with a valuable microscope and illuminated address. Mr. Humphrey is joining Dr. Mond as consulting engineer to the new Power Gas Company.

Appointments Vacant.—A traffic manager is wanted for the Bolton Corporation tramways at £250 (rising to £400). A chief assistant is required for the Bradford electricity works at £150 per annum. Various assistant lecturers and demonstrators are wanted for the Sunderland Technical Colleges. Until noon today the Garston U.D.C. is open to receive application for the appointment of consulting electrical engineer. A shift engineer for the Dublin electricity works. A head of the Physics and Mathematics Department is required for the Sir John Cass's Technical Institute at £250 per annum. An assistant engineer at £80 is required for Hanley; an assistant engineer for King's Lynn at £78 per annum; and a tramway manager for the B.E.T. Company.

Brill's English Works.—We have already announced that the J. G. Brill Company, of Philadelphia, are about to equip car works in this country. It is now stated that the company is negotiating for a site at Preston.

Late Correspondence.—The following letter comes to hand too late for insertion in our "Correspondence" columns:—

"We have in the past wound some of our smaller motor armatures with that particular type of form winding known as 'Eickemeyer,' and have inserted a description of same as one of our alternative windings in our catalogue.

"We learn, however, from Messrs. Parker & Co., Limited, that they are the owners of the patent in this country for this type of winding, and on looking into the matter find that this is correct.

"We naturally have settled amicably with Messrs. Thomas Parker and Co., Limited, and regret having inadvertently given them cause for action.

"The Eickemeyer winding must be distinguished from the barrel winding. In the latter case, though form wound, the winding is all on one plane, and is the alternative type of form winding to that of the Eickemeyer.

"D. Bruce Peebles & Co."

The following letter also arrived after our "Correspondence" columns were closed:—

"I notice that in this week's issue, on page 633, you say that the Erith U.D.C. has adopted E.C.C. alternators driven by Parsons turbines for the electricity scheme. I would like to point out that this is entirely a misstatement, as the order for the three three-phase steam alternators has been placed with my firm, the engines being by Messrs. W. H. Allen, Son & Co., of Bedford. The three-phase high tension switchboard, under Section E for the same contract, has also been secured by us.

"The International Electrical Engineering Company.
"E. Kilburn Scott, *Engineer and Manager*."

Obituary.—Mr. Frank H. Wilson, chief engineer to the Mansourah Electric Supply Company, died of diphtheria at Cairo on October 7th. He was buried in the British cemetery. The *Egyptian Gazette* says that he had just completed his engagement of two years with his employers on the day he was taken ill, and was intending to leave for England, when the end came. Mr. Wilson was born at Cowley Court, near Cheltenham. He was three years with Messrs. Crompton & Co., Limited, electrical engineers, at Chelmsford, and two years at University College, London. He was appointed to Mansourah in 1899, and has since carried out the electric lighting of that town with complete success.

We record with great regret the death of Mr. Carl Frederik Tietgen, which occurred last Saturday at Copenhagen from paralysis. The late gentleman, who was 72 years of age, was honorary chairman of the Great Northern Telegraph Company—in fact, it was he who, together with the late Mr. Erichsen and the late Mr. Hooper, organised the company. In addition to being associated with many other great commercial enterprises in Denmark, Mr. Tietgen was a Councillor of State. He rose from the commercial traveller of years gone by to a very eminent position in Danish commerce. Mr. Tietgen may justly be considered the pioneer in placing Europe in telegraphic communication with China and Japan. In this country, his name is principally known from the important part he took in the creation of submarine telegraph undertakings. As far back as the sixties he was connected with a scheme for providing telegraphic communication between Europe and America by way of Iceland, the Faroe Islands and Greenland, whilst Great Britain was to be connected by cables to Scandinavia. After the successful laying of the Atlantic cable in 1866—67, the Atlantic portion of the scheme was put in abeyance, but several cables were laid in the North of Europe in the succeeding years, and the various companies that laid them were in 1869 amalgamated as the Great Northern Telegraph Company. In 1870 another company, the Great Northern Telegraph China and Japan Extension Company was started with the object of providing telegraphic communication between Wladiwostock, the terminus of the Russian landline system, and China and Japan, which undertaking in 1873 was together with the Great Northern Telegraph Company in its turn amalgamated in the company now bearing that name, of which Mr. Tietgen was chairman from the beginning until 1897, when he retired on account of failing health, although he occupied until his death the position of honorary chairman. Mr. Tietgen died full of years and honours, his services having received recognition not only from his own country but also from several foreign countries.

Boiler Explosion Inquiry.—A three days' inquiry has just been held by Mr. G. Howard Smith, B. of T. Commissioner, into the explosion of a tube in a tubular boiler at the Castner-Kellner Alkali Company's works, at Weston Point, Runcorn. The explosion occurred on July 17th, a fireman being seriously scalded. The boiler was a Babcock; its heating surface was 3,580 sq. ft., and the evaporation about 11,000 lbs. of water per hour. Within 12 months no fewer than 18 tubes had been renewed in the boiler, all in the bottom row. The feed water from the condensers was analysed immediately after the explosion, and only a slight trace of grease was found in it. The burst tube was of Swedish drawn steel, and was tested to 1,500 lbs. pressure to the square inch. A large number of expert witnesses were called as to the cause of the explosion. The Commissioner, in giving judgment, said the opinion of the Court was that the overheating was caused owing to an oily deposit on the iron, and the boiler was too heavily fired and worked beyond its capabilities, having regard to the way in which it was fed. The Alkali Company and their employés were, however, absolved from blame.

Car Fender Competition.—The municipal authorities of Madrid have opened a competition for the best safety fender to be fitted to the electric tramcars in the Spanish capital. A premium of £80 is offered to the designer of the selected device. All entries and models must be sent, by November 5th, 1901, to El Negociado de Obras de la Secretaria del Ayuntamiento de Madrid, whence full particulars of the competition can be obtained.

Electrical Engineers Volunteers.—There will be a Smoking Concert at Headquarters on Saturday, November 2nd, commencing at 8 p.m. All members of the corps are requested to attend. Dress: blue serge and forage caps.

We read that it is in contemplation to form a company from the corps of Electrical Engineers Volunteers for service in South Africa as telegraph linesmen.

Institution of Electrical Engineers (Dublin Section).—There will be a meeting of this Section of the Institution on Thursday, November 14th, 1901, at the Royal College of Science, St. Stephen's Green, Dublin, at which a paper will be given by Mr. P. S. Sheardown on "An Account of the German Tour of the I.E.E."

For Sale.—On Tuesday next the lease of the Westminster Works, Doris Street, Kennington, S.E., and a considerable quantity of plant, tools, &c., are to be offered for sale by auction by Messrs. Worsfold & Hayward, auctioneers, of 80, Cannon Street, E.C.

Information Wanted.—A correspondent desires to know where he can procure a mechanical device for obtaining various speeds from an A.C. motor.

Electricity v. Other Illuminants.—"Fairplay" sends us a letter on this subject, but has omitted to enclose his name and address, which we require to know before we publish the letter.

THE CENTRAL STATION ENGINEER.

Sheffield Electricity Staff off Duty.—The Sheffield Corporation Electric Supply Department has a "Sports and Entertainments Association," under the secretaryship of Mr. Arthur Walkington. We understand that it was started as a wiremen's football club at the instigation of Mr. W. S. Johnston, who is now in charge of the Heywood electricity works, but it has become of considerably greater importance, taking in all the members of the department. Other central station men may be interested to learn that at the end of the last football season a general council was formed to govern committees formed to run the various clubs, and to provide indoor entertainment for the winter months. This council is composed of heads of departments and others representing the whole of the employés. There is one treasury, and with the council alone rests the responsibility of disposing of the Association's funds. The scheme enjoys the patronage of the Electric Light Committee of the City Council, with Mr. S. E. Fedden as president, and six other prominent officials as vice-presidents of the Association. Each employé pays 1d. per week, with a small entrance fee to each section of sport. With these conditions in force, it is very gratifying to the promoters to find at this early date a membership of 170, and a substantial balance at the bank. Up to the present, only cricket and football have claimed attention (with an occasional smoking concert), but it is intended shortly to take in hand swimming and other recreations. The "Electric Supply" football team paid a pleasant visit to Nottingham on the 12th inst., and were successful against a team picked from the employés of the Corporation, by 4 goals to 2. The visitors had the support of their president and several other important officials of the Sheffield Corporation. The party (numbering 37) were afterwards the guests of their Nottingham friends at a tea, over which the deputy mayor (Mr. Alderman Pyatt) presided. A pleasant exchange of courtesies followed, after which Mr. Fedden and party adjourned to the electricity works, to be kindly received and shown over the same by Mr. Herbert Talbot, the city electrical engineer. When the Nottingham contingent visit Sheffield for the return match in March next year, they will meet with a hearty reception.

Personal.—Mr. H. J. Mills, assistant engineer at the Beckenham electricity works, was recently married to Miss L. Hume, of Portsmouth.

The Harrogate Town Council recently refused to allow a driver, who had made certain allegations against individual members of the staff, to appear before them. The driver had been previously dismissed by the engineer-in-chief. Mr. G. F. A. Norman, mains superintendent, who has recently returned from the front, received the South African medal from General Gatacre at Bury St. Edmunds on Tuesday last, and is about to receive a gold medal from the town of Harrogate.

Mr. Frank Forrest is leaving the Tynemouth Corporation electricity works to take up a position as assistant engineer in the stations department of the Charing Cross and City Electric Supply

Company, Limited, and Mr. Lawson, of the British Thomson-Houston Company, Newcastle-on-Tyne branch, has been appointed in his place. A letter of congratulation to Mr. Forrest, expressing regret at losing him, was signed by every member of the staff, and duly presented to him.

Mr. A. Randall Bell, who is relinquishing the post of chief assistant at the Swansea electricity works to go to Uxbridge, has been presented with an honorarium of £20 by the Swansea Committee for having taken over complete charge of the works during the interval between the departure of the late chief engineer and the arrival of Mr. Prussmann.

Mr. F. H. Shaw, of Buxton, has been appointed electrical engineer to the Lincoln County Hospital. There were 122 applicants for the post.

Mr. Calvert has resigned the electrical engineership to the Buxton District Council. It seems that the Council had declined to allow a requested increase in salary, although they expressed a very high appreciation of his services.

Mr. G. O. Neville, one of the assistant engineers at Hanley electricity works, is leaving for a better post as assistant engineer to the Bournemouth and Poole Electric Supply Company. On 22nd inst. the Hanley staff presented him with a case of pipes with silver shield bearing a suitable inscription.

Mr. Arnot recently resigned the post of city electrical engineer at Melbourne. Applications for the position were invited, only Australians to be eligible; but it was intended that if this condition stood in the way of securing a first-class man, the advertisement would be subsequently inserted in American and English newspapers.

Mr. H. Tomlinson Lee, who has been assistant engineer at the Wakefield electricity works for the past five years, is leaving to become deputy chief at Wimbledon electricity works. His Wakefield friends, on Tuesday, presented him with a portmanteau and dressing case, and Mr. Blackmore, the electrical engineer, presided over the proceedings.

Annual Supper.—The second annual supper of the staff and employés of the Reading Electric Supply Company, Limited, was held on Monday, 21st inst., at "Rivernook," de Montfort Island, Reading, the residence of Mr. A. T. Cooper, the managing engineer. Every member of the staff was able to be present, as the party did not sit down until 11 p.m. After a good old-fashioned supper of roast beef and pudding a smoking concert was held, to which every member of the company contributed, and at which various toasts were enthusiastically drunk.

NEW COMPANIES REGISTERED.

Union Construction Company, Limited (71,610).—This company was registered on October 16th, with a capital of £200,000 in £20 shares, to undertake and carry into effect the application of electric equipment and traction to any railways or tramways in the United Kingdom or elsewhere, and the substitution of electric traction or power for steam power on any such railways or tramways, to construct subways or ducts, to lay down cables and rails, to build sub-stations, to alter existing railway stations, to execute all necessary works for the conversion of any railways or tramways using steam or other form of tractive power into railways worked by electric power, to manufacture rolling stock, engines, trolleys, trucks, electric motors and machinery, to purchase or lease any railways or tramways, and to carry on the business of electricians, civil and mechanical engineers, producers and suppliers of electricity for the purposes of light, heat and motive power or otherwise, &c. The first subscribers (each with one share) are:—Charles T. Yerkes, Hamilton House, Victoria Embankment, E.C., gentleman; James R. Chapman, Hamilton House, Victoria Embankment, E.C., engineer; William E. Mandelick, Hamilton House, Victoria Embankment, E.C., gentleman; Francis E. Vouillon, Hamilton House, Victoria Embankment, E.C., clerk; Samuel Peck, Calbourne, Wallington, Surrey, clerk; Cecil A. Grenfell, 4, Great Cumberland Place, W., stockbroker; and Inga Erickson, Hamilton House, Victoria Embankment, E.C., secretary. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, 50 shares; remuneration as fixed by the company. Registered office, Hamilton House, Victoria Embankment, E.C.

Mackenzie & Holland, Limited (71,637).—This company was registered on October 18th, with a capital of £150,000 in £1 shares, to acquire the business of railway signal manufacturers, iron and brass founders, and general engineers, carried on by W. Holland, W. Griffiths, S. P. Wood, and W. T. Page, as "Mackenzie & Holland," at Worcester and elsewhere in England, and at the Semaphore Works, Melbourne, Victoria, Australia, and the Toombul Interlocking Works, Brisbane, Queensland, Australia, to adopt an agreement with the said vendors, and to carry on the business of railway signal and interlocking apparatus makers, machine makers, tool makers, millwrights, mechanics, ironfounders, compressor manufacturers, metallurgists, smelters, refiners, engineers, contractors, manufacturers of pneumatic tools and appliances, makers of pneumatic, electric and hydraulic railway and marine signal appliances, &c. The first subscribers (each with one share) are:—W. Holland, Rose Hill, Worcester, engineer; Mrs. F. Holland, Rose Hill, Worcester; W. Griffiths, 61, Sinclair Road, W., engineer; Mrs. H. Griffiths, 61, Sinclair Road, W.; W. T. Page, Lynthorpe, Bromyard Road, Worcester, engineer; Mrs. F. L. Page, Lynthorpe, Bromyard Road, Worcester; and S. Southall, Guildhall, Worcester, solicitor. No initial public issue. The number of directors is not to be less than three nor more than six; the first are Walter Holland, William Griffiths, Sidney P. Wood, and William T. Page; qualification, £500 remuneration, £25 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Trafford Power and Light Supply, Limited (60,419).—Particulars of registered mortgages and charges:—Date of creation of mortgage or charge: February 11th, 1901; amount secured: £10,000; property charged: The undertaking of the company, all its property and assets (present and future), capital uncalled and capital called but unpaid; persons entitled to the charge: Messrs. W. T. Glover & Co., Limited, Trafford Park, Manchester.

SUPPLY STATION ACCOUNTS.

Tunbridge Wells Corporation Electricity Accounts.

For the first time since the Corporation of Tunbridge Wells started the electricity supply undertaking, the accounts show a net loss. As usual, the principal cause is the increase in the coal bill. Also, as is becoming common, there is a payment of interest and sinking fund, approximately equal to the loss, on the last capital raised, which has not yet been earning revenue, as the plant it covers has not started. The deficit on last year's working need not be carried forward, nor will it come on the rates, as there is a reserve fund standing at £2,039, which can provide the sum required. Again, the rates in years past have benefitted by no less than £2,750 out of profits made by the department.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£42,843	**£56,013**	£13,170
Number of units sold	496,297	**564,827**	68,530
No. of lamps connected.. ...	28,502	**35,260**	6,758
Maximum load in kw.	423	**470**	47
Gross revenue	£8,291	**£9,691**	£1,400
Gross expenditure...	£5,170	**£7,328**	£2,158
Gross profit	£3,121	**£2,363**	−£758
Average price per unit sold ...	3·57d.	**3·86d.**	+·29d.

According to Mr. Boot, the borough electrical engineer, the street lighting charges are lower than they should be, and he recommends that they be increased. This is a reasonable position to take up, considering that he shows the average for public supply is 1·03d. per unit, when repairs, carbons, and trimmers' wages have been deducted. The number of consumers is 600, being an increase of 135, while 6,760 lamps have been added during the year.

Revenue Statement.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£7,381	3·57d.	**£9,087**	3·86d.	+·29d.
Meter rents	266	·13d.	**315**	·13d.	·00d.
Attending public lamps ..	553	·27d.	—	—	—
Sale of ashes	22	·01d.	**14**	·01d.	−·26d.
Sundry fees	69	·03d.	**275**	·12d.	+·08d.
Gross revenue ...	£8,291	4·01d.	**£9,691**	4·12d.	+·11d.

Under the head of coal the increase has been £1,380, owing partly to the price paid having risen from an average of 20s. 9d. to 36s. 6d. per ton. Re-tubing the boilers accounts for a sum of £250 under repairs. Rates, &c., amount to £135, against £121 in the previous year, which is a rather heavier burden than similar undertakings are called upon to bear. Another heavy charge is that made for office accommodation and the services of the other borough officials, which is set down at £308. The result of the various increases is to raise the total cost by nearly ¾d. to over 3d. per unit. The largest reduction is in the item for salaries, wherein an economy has been made in the gross figure, which may or may not be to the advantage of the undertaking. Cutting down salaries sometimes leads to extra risk, waste and inefficiency, and Tunbridge Wells is notorious for extreme carefulness in the wages and salaries paid to the works staff.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal..	£2,446	1·18d.	£4,231	**1·80d.**	+·62d.
Oil, waste, water, carbons and engine room stores	220	·11d.	257	**·11d.**	·00d.
Salaries and wages incurred in generation and distribution, and attending street lamps	787	·38d.	885	**·37d.**	−·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and renewals public lamps	254	·12d.	383	**·16d.**	+·04d.
Works cost ...	£3,707	1·79d.	£5,756	**2·44d.**	+·65d.
Rent, rates and taxes ..	300	·14d.	369	**·16d.**	+·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c., and collector's commission.	1,048	·51d.	1,012	**·43d.**	−·08d.
General establishment charges, stationery and printing, law charges and insurance.	115	·06d.	153	**·06d.**	·00d.
Other expenses	—	—	38	**·02d.**	+·02d.
Total cost ...	£5,170	2·50d.	£7,328	**3·11d.**	+·61d.

As the costs increased by £2,158, and the revenue by £1,400 only, the gross profit is less by £758 than in 1899. At the same time financial charges absorb £489 more than before, and taking these two sums together, the change of £1,247, causing a net loss of £482 instead of a profit of £765, is accounted for. Mr. Boot shows that by allowing for the extra cost of coal, special boiler repairs and financial charges on dead capital, the net profit should have been £1,636, or more than double that of 1899.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans and dividends on stock	£1,214	£1,531
Sinking fund for repayments and redemption ..	1,142	1,314
Net profit carried forward	765	−482
Gross profit	£3,121	£2,363

CITY NOTES.

Western Telegraph Company.

THE directors' report for the half-year ended June 30th, 1901, to be submitted to the meeting on October 30th, reads:—

The directors submit the annexed accounts and balance-sheet for the half-year ended June 30th, 1901. The revenue for this period amounted to £228,892 1s. 9d., and the working expenses to £98,901 5s. 6d. After providing £10,291 10s. 10d. for debenture interest and sinking fund, and £3,847 13s. 9d. for income-tax, there remains a balance of £115,851 14s. 8d.; to this is added the sum of £7,689 0s. 1d. brought forward from December 31st last, making a total of £123,540 14s. 9d. A quarterly interim dividend, amounting to £31,189 10s. has been paid, £35,000 transferred to the general reserve fund, and £2,000 to the maintenance ships' reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £51,982 10s., leaving a balance of £3,368 14s. 9d. to be carried forward. The dividend and bonus will be payable on October 31st. The directors deeply regret that Mr. Frederick Youle, on account of advancing years compelling him to reduce his engagements, has resigned his seat at the board. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. Gane, Jackson, Jeffreys & Wells, offer themselves for re-election.

Cuba Submarine Telegraph Company.

THE sixtieth ordinary general meeting of the shareholders of this company was held on Wednesday at the offices, 58, Old Broad Street, Mr. Charles W. Parish presiding.

In proposing the adoption of the report, the CHAIRMAN said it was usual to compare the results of the past six months with those of the corresponding half of the preceding year. They would remember that in May, 1900, it was found necessary to lower the local rates of the company, and as the reduction was very considerable, they must not be surprised that the actual traffic receipts were less for the half-year under review than they were during the first half of 1900. It would perhaps give them a better comparison if he placed before them the results of the last three half-years. The first half of 1900 showed that the traffic receipts were £13,177. The second half-year gave the traffic receipts £8,903, and the first half of the present year, which was the one under review, showed the traffic receipts at £9,981, or about £1,000 more than the preceding six months. He must remind them that the first half of the 12 calendar months represented the busy period of the sugar crop in Cuba, and therefore the increase to which he had alluded was only to be expected under the normal condition of the island. They would notice from the report that the total receipts for the half-year amounted to £12,007, while in 1900 they reached the total of £15,336. That, therefore, showed a falling off of £3,329, which was a very serious amount, but was accounted for, as he had already explained, by reductions they were forced to make in the local rates. Fortunately their expenses had been somewhat reduced during the last half-year. They amounted to £5,519 as against £6,296 in the corresponding period of 1900, a decrease of £777. The result was that a balance remained of £6,488 as against £9,039 in 1900. On the items of expenditure there was very little to be said. As he had explained before, in a small cable company like theirs there was a certain staff required for the carrying on of the business, and although from year to year there might be some adjustments of salaries, &c., on the whole there was no variation which required explanation. Of course in special times, such as when the Spanish-American war was in progress, the offices had to be kept open night and day, and there was a heavy item for overtime resulting therefrom. But now they had returned to a period of peace, he did not think they could look for any reduction in their present expenses. He would like to mention while on the point how exceedingly unfortunate it was that they had to bear the heavy expense of the coast cables without receiving the help of a subsidy. He might tell them that no reply had been received from the Government of the United States regarding the payment of the subsidy of £2,000, which was now in arrear since January, 1899, and although they expected to receive the sum eventually, it would be a great convenience that it should be paid to them promptly. He also regretted that another six months had elapsed, and still no definite opinion had been arrived at as to their concession being recognised by the United States Government. Matters were practically the same as when they last met. The concession had been referred from Cuba to Washington, but he was afraid that until the position of Cuba had been finally settled, no definite progress would be made. As regarded the claim which they had made of £8,174 for damage done to their cables during the Spanish-American war, the late president, Mr. McKinley, in 1900 had recommended their claim to Congress. It had never actually come before the Congress, but it was hoped when the Congress next met they would hear that their compensation had been voted to them. It must be evident to all of them who followed the affairs of the United States and Cuba that it was very difficult to settle up the company's claim while the two countries were so unsettled. The company had had the Manzanillo-Santiago section of their cables interrupted during the year, which he feared was one of those unfortunate losses which cable companies were subject to. The injury had occurred towards the Cape Cruz end of the cable, where the water was very deep. Mr. Keith, their engineer, had the matter in hand, but he feared it would entail a large sum of money to repair it. The law suit which the company had against the West Indian and Panama Company, he believed, would come on again early next year in the House of Lords, and he trusted they would be as successful as they had been in the two lower Courts.

Mr. GEO. KEITH seconded the motion, and the report was adopted.

Hampstead Electric Supply Company.

AN extraordinary general meeting was held on 21st inst. at the Institute of Chartered Accountants, Moorgate Place, E.C., for the purpose of considering resolutions for reconstruction.

Mr. E. T. READ, who presided, said that the ordinary meeting would have been held some three or four months ago, but the directors had been engaged for the last eight months trying, by the reorganisation of the debenture capital, to raise a further amount of working capital, which was absolutely necessary. Their efforts in that direction had proved fruitless, and therefore there was no other alternative than to reconstruct the company. Some of the shareholders, no doubt, thought the company had not been as well managed as it might have been, but he would like to point out that it was very difficult to manage an increasing business with practically no funds. Within the two years since he had been on the board, they had practically doubled the electric lighting business; that was to say, the number of houses had increased from 500 to close upon 1,000. Had it not been that they were hampered by the lack of working capital, their business would have been far bigger. There was a large amount of business waiting for them. The business of Taylor & Lown had also increased largely, although the profits resulting therefrom had not been quite satisfactory to the board. There was no doubt that it was a very good business in itself, but the directors had decided, with the approval of a considerable number of the large shareholders, that in the future the business of the company should be confined solely to electric lighting. Dealing with the scheme of reconstruction, he said that the capital of the new company would be £150,000, divided into 100,000 preference shares and 50,000 ordinary shares. The preference shares, it was proposed, should have a preferential interest of 5 per cent.; and they also suggested, subject to the approval of the meeting, that after the ordinary shareholders had received 5 per cent., the preference shares should take one-third of the surplus profits, the other two-thirds going to the ordinary shareholders. The capital of the company would be guaranteed, and he was pleased to say that there would be no difficulty in that direction. The debenture issue of the new company would be reduced to £25,000—£12,500 "A" debentures and £12,500 "B" debentures, both bearing interest at the rate of 5 per cent.; but it was quite possible that, instead of there being two classes of debentures, there might be only one. He must ask them to leave that matter to the board's discretion. As regarded the future, the profits on their present business, carefully estimated for the next year—assuming that the price of coal remained at its present rate, namely, between 23s. and 24s. per ton—would be from £6,500 to £7,500. Personally, he would have to pay up, in connection with the reconstruction, £2,000 or £2,500, and one of his colleagues would have the pleasure of finding £3,000 or £4,000; in fact, the board were interested in the company to the extent of about one-sixth of its capital. Mr. A. W. Armstrong, the founder of the old Hampstead Battery business, had consented to join the directorate. In conclusion, the chairman moved the resolutions for reconstruction.

Mr. A. C. B. CASSON seconded the motion.

After a good deal of discussion, the resolutions were agreed to.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Brompton and Kensington Electricity Supply Company, Limited.—Further issue of 8,000 7 per cent. cumulative preference shares of £5 each, fully paid, Nos. 50,001 to 58,000. Waygood (R.) & Co., Limited.—35,000 vendors' ordinary shares of £1 each, fully paid, Nos. 1 to 35,000; and 35,000 vendors' 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 35,000. Application has been made to the Committee to allow the following to be quoted in the Official List:—Cape Electric Tramways, Limited.—Further issue of 40,000 shares of £1 each, fully paid, Nos. 400,001 to 440,000. (Renewed application.)

Monte Video Telephone Company.—The report for the year ended July 31st shows a net profit of £10,319, after providing for working expenses in Monte Video and London. To this amount should be added £1,886 brought forward, leaving an available balance of £12,205. The directors propose to transfer £5,000 to reserve, and recommend a dividend at the rate of 2½ per cent. per annum on the ordinary share capital, a balance of £1,063 being carried forward.

Isle of Man Tramways Company.—On Wednesday last week at a meeting of the debenture holders of the Isle of Man Tramways and Electric Power Company, a proposal of the liquidator of the company, Mr. W. H. Walker, to apply the £50,000 to be received from the Corporation of Douglas for the horse and cable sections of the tramways at Douglas to pay off the "A" class of debentures was agreed to. This leaves the "B" and "C" debentures the only charges on the electrical sections and other property of the company.

Calcutta Electric Supply Corporation, Limited.—Interim dividend at the rate of 5 per cent. per annum for the half-year ending June 30th last. Letters of allotment and regret in the recent issue of 10,000 shares have been posted.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Oct. 18th were £555; corresponding week last year, £414; increase, £141. Total to date, £21,219, corresponding period last year, £18,909; increase, £2,310. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending October 19th were £300; corresponding week last year, £259; increase, £41. Total receipts to date, £19,170; corresponding period last year, £18,664; increase, £506.

Bristol Tramways and Carriage Company.—The receipts for the week ending October 18th were £4,040; corresponding period last year, £2,994; increase, £1,046.

British Electric Traction Company's Lines.—The following returns are issued of the undertakings of this company for the week ended October 11th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon†	582	237	..	41	12,099	..	*302
Devonport	232	..	..	16	6,615	..	..
Dudley—Stourbridge	672	319	..	41	27,022	14,736	..
Gateshead	623	..	..	22½	13,166	..	..
Hartlepool	243	39	..	41	9,336	1,160	..
Kidderminster	110	7	..	41	5,137	605	..
Merthyr	223	..	..	27	7,143	..	..
Oldham—Ashton	488	478	..	41	20,594	1,730	..
Poole	247	..	..	27	8,243	..	..
Potteries	1,426	228	..	41	57,322	17,896	..
Southport	164	..	18	41	6,930	..	*2,643
South Staffordshire‡	810	29	..	41	31,847	2 269	..
Swansea	433	26	..	41	18,181	4,063	..
Taunton	74	..	..	7½	795	..	..
Tynemouth	210	..	..	29	8,813	..	..
Wolverhampton Dist.	90	37	..	41	2,695	528	..

* Under reconstruction. † Part horse. ‡ Part steam.

Central London Railway.—The receipts for the week ending October 19th were £6,325; corresponding week last year, £5,466; increase, £859. Total receipts from July 1st (16 weeks), £93,760. Miles open, 6.

City and South London Railway.—The receipts for the week ending October 20th were £2,071; corresponding week last year, £1,708; increase, £363. Total from July 1st to date, £30,371; corresponding period last year, £24,592; increase, £5,779. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending October 19th were £218 7s. 2d.; corresponding week last year, £198 0s. 5½d.; increase, £20 6s. 8½d. Total to date, £9,854 15s.; corresponding period last year, £8,875 0s. 2½d.; increase, £479 14s. 9½d. Miles of track open, 3; Car miles run, 1901, 5,343; 1900, 4,966. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending October 18th were as follows:—D.U.T. Co., electric cars, £3,544 11s. 3d.; D.S.D. Co., electric cars, £781 17s. 6d.; total, £4,326 8s. 9d.; corresponding period last year—D.U.T. Co., electric cars, £3,468 16s. 5d.; ditto, horse cars, £27 2s. 2d.; D.S.D. Co., electric cars, £749 16s. 6d.; total, £4,245 15s. 1d.; increase, £80 13s. 8d.; aggregate to date, £79,129 0s. 2d.; aggregate to date last year, £77,988 13s. 5d.; increase, £1,140 6s. 9d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Glasgow Corporation Tramways.—The receipts for the week ending October 19th, 1901, were £13,657 11s. 2d., compared with £9,251 13s. 7d. for the same period last year.

Liverpool Overhead Railway.—The receipts for the week ending October 20th were £1,461; corresponding week last year, £1,594; decrease, £133. Total from July 1st to date, £26,446; corresponding period last year, £27,376; decrease £930. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Apart from the gambling markets, the current account is easy enough to settle in the Stock Exchange, and with a nineteen-day settlemen now ahead, the House has little to fear from internal troubles once the dread Friday, when this journal appears, is passed. Money remains plentiful as ever, and the prognosticators of an autumn squeeze in Lombard Street are redating their prophecies. But while money is not worth more than 1 to 1½ per cent., Consols are depressingly dull, their slight increment of strength last week having more than evaporated. Partly as a sequel to the fall in the funds, our price lists display a general inclination to weakness. Manufacturing shares stand out as exceptional to the prevalent dulness, and in the home railway market Central Londons continue their upward movement.

Of the Electricity Supply shares, Chelsea Ordinary remain weak, the price keeping in the near neighbourhood of 5, but last week's drop in Notting Hill shares has been recovered. Westminsters are easier on sales in a limited market, and for some occult reason the Stock Exchange does not take kindly to the idea of an inquiry being instituted into the whole question of fogs in the London area. Such an inquiry can, at least, do the electricity supply enterprises no harm, and it might help them very considerably, for obvious reasons. The approach of winter means good business for the companies, and investors should certainly not sell their electrical shares in the present dull state of the market.

There are many hapless shareholders in the Hampstead Electric Supply Company who are debating whether they should join the scheme for reconstruction or not. They might consider one or two facts. The company has practically no *locus standi* in the district it serves; no Parliamentary powers, for instance. It supplies light to one small part of Hampstead, and how many lights the houses therein contained are burning, the chairman has not told us—perhaps wisely. At the meeting the other day the chairman is reported to have said: "Although the company might have a special settlement and an official quotation, unless there were active dealings in the shares, they would rarely be quoted." As a matter of fact, an official quotation would cause the shares to be quoted every day, and that twice, in the Official List published under the Stock Exchange Committee's auspices. But, as a matter of fact, we have never seen them officially quoted. The nominal price of the shares for long was supposed to be about £5, but sellers found it exceedingly hard to get as many shillings. Under the circumstances, reluctant as we are to advise abandonment of any shares, this is a case in which proprietors will do well to leave the game to the insiders, and have nothing more to do with the unfortunate affair.

Once more have Central London Ordinary and Deferred stocks registered a rise, the wretched weather in the earlier part of the week encouraging hopes of a bumper traffic. Great Northern and City Preferred are steady at 8¼, Metropolitan keeps at 77, and District at 28. Traction descriptions present little noteworthy feature. Calcutta trams at 8 are better, thanks to the good report. London United Tramways 4 per cent. Debenture stock is hard at 106, and it is amusing to notice the fears entertained by some folks as to the security of Great Western Railway Ordinary stock, now that electric traction is making such strides in the Western and North-Western Districts of London. We should hardly say that the trunk lines were in serious danger yet awhile Mr. Forbes, of the Brighton Railway, says that his company will be prepared to run electric trains between Victoria and Brighton in four years' time if it is necessary, and the chairmen of the Great Eastern, Great Northern, and the North-Western are all considering the question of the new system. The London County Council is being urged to take steps for the electrification of the North Metropolitan Tramways Company's lines, and as the fully-paid £8 shares of N.M.T. stand at 4¾, the agitators should find their way not wholly unpaved.

The miscellaneous division boasts a rise of 20s. in Callender's Construction shares on the good dividend, not to mention the bonus which proprietors will receive from the issue of 5,000 new Ordinary at par. The new "sixths" are quoted about 30s. premium. Henleys are unaltered at 17, but the Debenture stock is two points better, and Electric Construction Debenture has improved to the round 100. That this class of security is now being sought is further evidenced by the widening, upwards, of the quotation for Telegraph Construction Debenture, although very little stock has changed hands lately.

Turning to telegraphs, Eastern Ordinary and Eastern Extensions are both easier, despite the agreement made by the latter with the Americans who are working the Hawaii scheme, the agreement to cover Asian connections with Manila. Anglo-American Deferred are flat on speculative selling, induced by the idea that American prices are on the crest of their rise, while Globe Ordinary have receded ¼ in the general dulness of the market. National Telephones are distinctly lively, but after being both higher and lower, the price is just the same as it was a week ago.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Oct. 16th.	Closing Quotations Oct. 23rd.	Business done during week ended Oct. 23rd. 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —103	99 —102	...	...
119,700£	Amason Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½ %	52 — 55 xd	52 — 55	...	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99 xd	97 — 99	98½	97⅝
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	10½ — 10⅝	9¾ — 10¼	10¼	10
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½ — 4	3½ — 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101⅝	101½
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½ — 14½	13½ — 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4 xd	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½ %	3½ %	3½ %	10½ — 11½	10½ — 11½	11⅛	11
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	139 —144 xd	138 —143	141	138
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	95 — 98 xd	95 — 98	96½	95
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	115½	114½
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	13¾ — 14¼	14⅜	13⅞
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	114 —119	114 —119	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5½ %	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104 %	101 —104 %	103	...
180,227	Globe Telegraph and Trust	10	5⅛ %	5¼ %	5¼ %	11¼ — 11⅜	11 — 11¼	11⅝	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	...	...	15 — 15½	15 — 15½	15⅛	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	...	15 %	30 — 32	30 — 32	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	41 — 45	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½ %	...	¼ — ½	¼ — ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝ — 1	⅝ — 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4¼ — 4½	4¼ — 4½	4 9/16	4 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	13¼
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	4 1/16	4⅛
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	96 — 99	96 — 99	96⅜	96
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	96 — 9	96 — 99	97⅛	96⅜
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	15/16 — 1 1/16 xd	5/16 — 1 1/16	1	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7⅞	7⅛
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130 xd	125 —130	126	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5¼	5 — 5⅛	5⅛	5
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5⅛	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼ — ⅜	¼ — ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	10 ½	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½ — 15	14½ — 15	15½	14 13/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2 %	8⅞ %	...	¼ — ½	¼ — ½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104 xd	101⅛	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞ — 8¼	7⅞ — 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼ — 8⅜	8¼ — 8⅜	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 5⅝	5½	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½ %	5½ — 6	4⅜ — 5½	5 3/16	5
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½ — 9⅛	8 — 9	8⅜	8¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½ — 9⅛	8½ — 9⅛	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	104 —107	104 —107	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5⅜ — 6¼	5⅜ — 6¼	5⅜	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½ — 6	5½ — 6	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	106½ —106¼	105 —108	107	106⅜
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	11¼	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼ — 1⅜	1¼ — 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	..
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	12½ — 13½	12½ — 13½	13½	13 3/16
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	113⅜	113
250,000£	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	98	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16	15½ — 16½	...	.
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½ %	14½ %	14½ %	15 — 16	15 — 16	15½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9⅛	8½ — 9⅛	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3	2½ — 3	...	...
79,900£	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½ %	11½ — 12½	11 — 12	11¾	11 9/16

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange..
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Oct. 16th.	Closing Quotation Oct. 23rd.	Business done week ended Oct. 23rd, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14 — 15	14 — 15	14½	14⅛
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11¾ — 12¼	11¾ — 12¼	...	...
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —124	121 —124	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¼ — 5⅝	5¼ — 5⅝	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	...	6 %	1 1/16 — 1 1/8 xd	1 1/16 — 1 1/16	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1½ — 1⅝	1½ — 1⅝	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2⅛	2
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	104	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	15 — 16	16 — 17	16¾	15½
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	6 1/16	5⅝
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	102 —105	104 —107	106	104
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	107	106¾
440,100	Do. do. Def. do.	Stock	...	...	...	99 —102	101 —104	104	102
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	51 — 54	51 — 54	52½	52
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 5⅛xd	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	¼ — ⅓	¼ — ⅓	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89 xd	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾ — 2¼	1¾ — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	2⅞	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —100	98 —102	101½	100½
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	9¾ — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	97 —100 xd	97 — 100	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16½ — 17½	16½ — 17½	...	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	5½	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	110 —114	112 —116	..	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	22 — 23	22 — 23	22⅝	22⅜
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103 xd	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅝%	3½%	6 13/16 — 6 15/16	6⅞ — 6⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	... — ...	15½—16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	38 — 42	38½	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	104 —105	104 —106	105¾	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6 xd	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/— 4/-
National Electric Free Wiring, 17/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10½—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (June 13th, 1901).

MARKET QUOTATIONS, Wednesday, October 23rd.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	82/-	82/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	95/	80/-	15/- inc.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £125	dec.
c Brass (rolled metal 2" to 12") basis	per lb.	7⅞d.	7⅞d.	..
c Tube (brazed)	per lb.	9¼d.	10d.	¾d. dec.
„ „ (solid drawn) ..	per lb.	9¼d.	8¼d.	..
„ Wire, basis	per lb.	7⅞d.	7⅞d.	..
Copper Tubes (brazed) ..	per lb.	10d.	11d.	1d. dec.
c „ „ (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£80	£80	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£80	..
g „ Rod	per ton	£80	£80	..
e „ (Electrolytic) Bars ..	per ton	£82	£82	..
e „ „ Sheets ..	per ton	£90	£90	..
e „ „ Rod ..	per ton	£84	£84	..
e „ „ H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	3/-	3/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/7½	3/6½ to 3/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	45/0½	45/7½	7d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i „ Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£11 15 to £11 17 6	£11 15 to £11 17 6	..
g „ „ Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £18	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£116 10 to £117 10	£118 to £119	30/- dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand .. .	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 tea. F'lax	per lb.	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	4 1/2d.	4 1/2d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¾d.	4¾d.	..
j „ 180 lbs. Jute rove	per ton	£10 7 6	£10 7 6	..
k Zinc, Sh's. (Vielle Montagne ord.)	per ton	£22 10	£22 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. (Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

LOSS IN ECONOMY BY THE INEFFICIENT COMBUSTION OF FUEL.*

By A. BEMENT.

(*Concluded from page* 653.)

If the operator entered upon his work in earnest, and made a study of conditions, he would discover that with composition A the air supply was too large, or that the coal supply was too small, generally the latter. The trouble with composition B would be that the condition of the fire was irregular; but, by being levelled and made uniform, the gas composition would change and be similar to D. The condition C shows that the air supply through the fire is obstructed and not uniform, and that the coal burning capacity is reduced, but that the air leakage into the furnace continues at the same rate, and is relatively larger in proportion, owing to less coal burning; it may be compared with D, showing much less air but complete combustion.

Condition E illustrates the effect of heaping in an excessive amount of coal at each coaling, and composition F shows what the result is when this burns down 20 or 30 minutes later.

An examination of these sample compositions will show that the carbon dioxide is influenced in amount by the conditions; in A it is low, owing to too much air; in B, owing to both too much air and carbon monoxide, caused by irregular conditions; in C, by the fire being dirty; in E, by bad coaling, and in F by a very low fire; while with D and the absence of the foregoing faults, the carbon dioxide is high.

In view of the showing here given, it will appear that if there were any advantage in the method, the operator could pursue his studies by watching the conditions, and knowing the amount of carbon dioxide only. This fact was taken advantage of by Arndt, a German inventor, who designed a continuous and automatic machine to indicate carbon dioxide in a moving sample of the gas, and which saves the labour, trouble, and delay of the analysis. This instrument is shown in fig. 2, and is known as Arndt's econometer. It consists of a laboratory balance, having a glass globe instead of the usual weighing pan, and being fixed in an air-tight case, 7, having a plate-glass front. A coupling, 40, is connected by a ⅜-in. pipe to the flue of the boiler, about 2 ft. from the damper, and another connecting joint, 39, leads through a similar pipe to an aspirator in the main flue between the damper and the chimney, or the chimney itself. This constantly draws a sample of the gases from the boiler flue through filters, gas pipes, and the balance, discharging it back into the chimney. In the interior of the case, 7, the joint, 40, is connected with the ascending pipe, 23, and the joint, 39, with the descending pipe, 22, by means of india-rubber tubes, 34 and 35.

The gas-weighing machine itself consists of a very finely adjusted and highly sensitive balance, to which is fixed a pointer. On one end of the balance is suspended an open glass globe, 18, having a capacity of about a pint, and on the opposite end a compensating rod, 32, to which is affixed a scale-pan with a number of glass beads and filings, by means of which the gas-holder may be balanced. The knife edges of the balance are steel gilded, and the caps are of agate. The whole balance is mounted on a pillar screwed on a cast plate, 28. The latter has adjusting screws, by means of which the balance is set both horizontally and vertically; in order to indicate the proper setting, a small pendulum is attached to the supporting pillar. A frame, 27, is fixed on the pillar, in which is inserted the scale card. The gas-ascending pipe, 23, reaches into the gas-holder or weighing globe, 18, which has a neck, 20, open below, and surrounded by a cup, 21, open above. The neck, 20, has free play around the glass tube, 19, as well as cup 21, so that the gas-holder can swing free from resistance. The combustion gases having to pass through filters and drying chambers, enter the weighing globe thoroughly cleansed and dried. As carbon dioxide is about 50 per cent. heavier than air and the other gases in the chimney, the weight of the gases which continually fill the weighing globe will be greater than that of air in proportion to the amount of carbon dioxide contained therein. The scale, 27, is so divided, that the movement of the pointer from one division to another corresponds with the volumetric percentage of carbon dioxide in the gases to be weighed. The amount of carbon dioxide in the gases can therefore be read off directly at all times.

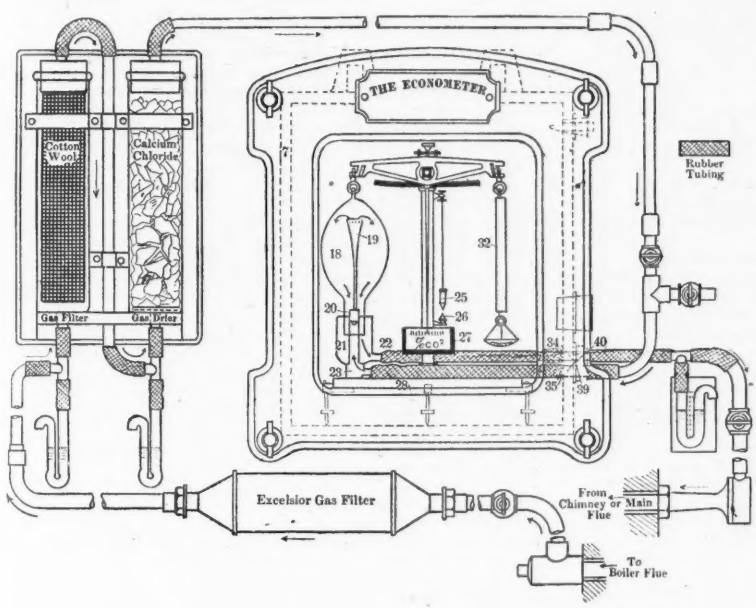


Fig. 2.—Arndt's Econometer.

This instrument is usually mounted at a convenient point on the wall of the boiler room, and pipes are extended from the different boilers to a header near the instrument, and delivering to it; by cutting in or out a pipe by means of a stop-cock, any boiler may be tested, or by enclosing this header, a test may be made of the work of any fireman without his knowing it.

About once a week the instrument should be tested for the zero point, by drawing air through it by way of the cock on the tee attached to pipe 39, with the upper cock closed, and the cock on pipe 40 open as in regular use. Adjustment for zero is made by removing a rubber plug in the side of the case, and adding or removing iron filings in the scale pan by means of a magnetic needle. About once a month the filter should be withdrawn from its chamber and brushed off. From once to twice a month the calcium chloride which has been used should be replaced. Every day the gas pipes between the header and the boilers should be blown out with air; where compressed air is available, this is best done by means of a three-way cock between the air pipe and header, but if the air under pressure is not available, a hand-pump may be used.

Soon after the advent of the econometer, the gas "Composimeter" was brought out; it also indicates carbon dioxide, but by chemical means. The principle involved is the reduction of the volume of gas by removing the CO_2, and the amount of this reduction is in proportion to the amount of CO_2; the reduced pressure consequent upon the reduced volume is communicated to a water column, which rises or falls over a graduated scale. The usual arrangement is to provide a separate instrument for each boiler, and to locate them in a special room.

Should the engineer be ambitious to make examinations of gas mixtures for possible hydrocarbons, the best instrument would be Hempel's apparatus, which consists of an aggregation of measuring burettes and various pipettes; it is a laboratory apparatus, and is not readily portable. This instrument, however, would be of such slight practical value in electric station management as to exclude its consideration.

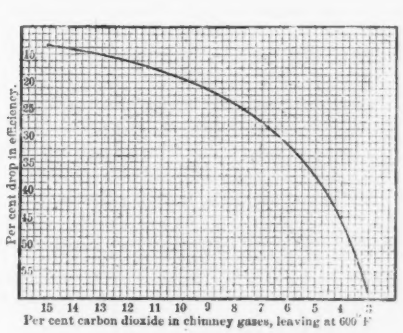


Fig. 3.—Percentage Curve.

As to the extent of the use of the devices mentioned, it should be said that the Orsatt apparatus (Eimer & Amend, chemists, of New York), is universally acknowledged the world over as the best for the purpose; all text-books mention it, and it is extensively used in all countries except the United States, although quite a large number have been purchased here. The econometer is in use in 15 or 16 different countries, even in the Philippine and Sandwich Islands, India and China, but its use in the United States is rather limited as yet, only the better managed plants taking it up. The gas com-

* *American Electrician.*

posimeter has had but a limited application; likewise Arndt's chemical CO_2 instrument.

These instruments may be mentioned in the order of their cost, beginning with the lowest priced, the Orsatt, Arndt's chemical CO_2 instrument, the econometer and the gas composimeter. The CO_2 machines are not often mentioned in the text-books, and where they are referred to, it is usually as novelties, or, possibly, as scientific toys. Later, when their value is better understood, they will be considered differently. The writer in his work uses two special forms of the Orsatt apparatus; a combination of the Orsatt and Hempel; the Hempel apparatus; the econometer and Arndt's CO_2 chemical instrument, but finds the econometer and chemical CO_2 instrument most useful as a guide in working fires for best efficiency.

The inquiry likely to be made by the station manager is, "What saving can be made?" This will depend on what his losses are now. It is a conservative estimate, however, to place the unnecessary losses at from 10 per cent. to 20 per cent. If an Orsatt instrument is purchased and set on the shelf after the novelty of a few days' use has passed, or if an econometer is installed and likewise treated, the investment will be money wasted. But, on the other hand, if they are made proper use of, their value becomes very large. Unless a station, however, is a very small one, it will usually be desirable to place a competent man in direct charge to ensure success.

As illustrating the loss owing to bad combustion, the accompanying diagram (p. 689) is of interest. It is based on complete combustion, and shows the minimum loss with gases leaving at 600° F. for various reasonable ranges of CO_2.

There is a great opportunity for improvement, which will eventually be realised when the station manager gives the fuel matter and the boilers the same degree of intelligent consideration that he does the other engineering features. There is a great opportunity in electric lighting and railway work where loads change so much, to make most important gains in efficiency, and the writer will say that the average station manager will find in the fuel matter his best opportunity for saving, provided he goes about the matter in the right way, and he may be able to save the investment cost of new boilers in some cases.

In a station burning 50 tons of coal a day at $2 a ton, a saving of 15 per cent. would obviously mean $15 a day, and it would pay to put on a special man who would be trained to his duties; even if he were paid $4 or $5 per day, it would be a profitable investment.

CURRENT SPECIFICATIONS.

LXXX.—MANCHESTER EXTENSION PLANT.

SUMMARY.

Extent of Contract.—(*a*) Supply and erection of two triple-expansion four-crank steam engines, each to develop 6,000 I.H.P. at 75 revolutions.

(*b*) Supply and erection of two 3,750-KW. 6,300-volt three-phase alternators, 75 revolutions; and

(*c*) Supply and erection of 48 motor-generators, all as specified below.

Type of Engines.—Each to be triple-expansion vertical four-cylinder four-crank engines, with one high pressure, one intermediate, and two low pressure cylinders. Height from floor line to top of cylinder not to exceed 30 ft., and heaviest part not to weigh more than 45 tons.

Position of Alternator.—Alternator to be placed outside low pressure portion of engine near the fly-wheel. Large screens of thick plate-glass suitably fixed are to be placed between engine and alternator to minimise possible splashing of oil.

Design of Plant.—In designing the plant the total length is to be reduced as much as possible.

Specified Speed.—Seventy-five revolutions per minute.

Specified Steam Pressure.—At engine stop valve 190 lbs. per sq. in., the steam being superheated up to 500° F.

Type of Condensers.—Jet condensers to be provided capable of maintaining a vacuum of 27 in. Air and water pumps to be preferably direct driven from one end of engine.

Specified Overload.—6,500 I.H.P. for two hours when working condensing.

Details of Engines.—Valve gear to be of Corliss or other type which has proved itself successful in practical use on engines of equal horse-power. The specification is fairly open, and may be met by builders of repute without undue alteration of standard designs. Provision is to be made for controlling the cut-off of the engines from the switchboard gallery.

Specified Range of Governing.—Two governors to be fitted to each engine, one to act as an emergency governor to cut off steam automatically and by hand if speed of engine increases by 6 to 10 per cent., as arranged. The main governor is to control speed within *two per cent.* above or *two per cent.* below normal speed between no load and full load, or a momentary variation of 5 per cent. if all load suddenly thrown off. The variation at quarter-load must not exceed 1½ per cent. Hand adjustment within 5 per cent. of normal speed to be provided.

Permissible Variation in Angular Velocity per Revolution.—Not to exceed $\frac{1}{300}$.

Type of Alternator.—To be suitable for three-phase working with star-wound armature having centre point connected to a suitable terminal for connecting to earth if necessary.

Periodicity.—50 ~ per second.

Voltage of Exciting Circuit.—200 to 225 volts.

Normal Voltage of Alternators.—6,300 to 6,600 volts between adjacent conductors.

Normal and Emergency Load.—3,750 KW. at above voltage when working on inductive load with power factor of ·87, or 4,250 KW. when working on non-inductive load with power factor 1, and as emergency load 4,900 KW. for half an hour.

Method of Construction.—Fixed armatures with revolving field magnets.

Parallel Running.—Leblanc's damping or amortisseur coils or other approved electrical device to ensure perfect parallel running to be supplied.

Exciting Watts.—Not to exceed 36,000 watts with full load and power factor 0·87.

Temperature Rise.—Not to exceed 70°F. after 24 hours' running at normal full load and current.

Permissible Drop in Volts.—With constant speed and excitation not to exceed 7½ per cent. between no load and full load with power factor of 1, or 18 per cent. under similar conditions with power factor of 0 87.

Specified Insulation Resistance.—After six hours' full load run not to be less than 1 Ω between armature and core or magnets and core.

Specified Flashing Test.—14,000 volts alternating applied for one hour.

Specified Efficiency.—With power factor unity, full load, 97 per cent.; half load, 96 per cent.; and quarter load, 94 per cent.

With power factor 0·87, full load, 97 per cent.; half load, 95 per cent.; quarter load, 91 per cent.

Guaranteed Steam Consumption.—The engine efficiency at full load must not be less than 91 per cent., and the steam consumption per I.H.P.-hour with 190 lbs. sq. in. pressure steam at temperature of 500° F., shall not exceed 11 lbs. condensing with 27 in. vacuum, or 18 lbs. per I.H.P.-hour exhausting to atmosphere.

Guaranteed Oil Consumption.—Not to exceed two gallons of cylinder oil per 10,000 KW.-hours.

Number of Motor-Generators.—Forty-eight in all, viz.:—

Thirty-eight to consist of 150-KW. direct current dynamos, directly coupled to high tension three-phase synchronous motors.

Ten to consist of two 50-KW. direct current balancers driven by directly connected three-phase high tension induction motors.

Voltage of 150-KW. Dynamos.—As shunt machines 400 to 450 volts, as compound wound machines 500 to 550 volts.

Voltage of Synchronous Motors.—6,500 volts.

Voltage of 50-KW. Dynamos.—200 to 225 volts, for use on either side of three-wire lighting system.

Voltage of Induction Motors.—6,500 volts.

Speed of Motor-Generators.—Optional, but to be stated in tender.

Stipulated Overload.—All motor-generators to be able to stand an overload of 25 per cent. for half an hour.

Combined Efficiency.—Of the 150-KW., not to be less than 84 per cent. at full load, and of the 50-KW. sets, not less than 81 per cent. at full load.

Specified Dates of Delivery.—First engine and alternator, 12 months, second set 15 months from date of order.

Motor-Generators.—Earliest dates possible to be stated.

Penalty for Late Completion.—*Engines*, £100 per week per engine.

Alternators.—£100 per week per alternator.

Motor-Generators.—£20 per week per machine.

Contingency Allowances.—£2,000 in engine section, £1,000 in alternator section, £1,000 in motor-generator section.

Specified Terms of Payment.—Up to 85 per cent. on delivery, 10 per cent. on taking over, 5 per cent. at end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—Standard rates to be paid, and hours of labour observed.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—November 13th, 1901.

This is the second instalment of plant for the Stuart Street generating station of the Manchester Corporation for which tenders have been invited during the present year.

In the spring, specifications were issued, prepared by Prof. Kennedy, for six 1,500-KW. steam alternators, some steam exciters, and in all 40 motor-generators. It will be remembered that some correspondence took place in the public Press by reason of the order being placed with a foreign firm, though it was understood that the engines would be built in this country.

The present specification is signed by Mr. G. F. Metzger, the chief engineer to the electricity department of the Manchester Corporation, and asks for two 3,750-KW. steam alternators, and in all 48 motor-generators. These machines are probably the largest electrical generating units for which tenders have been invited by any British municipality, though we believe that orders for plant of this output have been placed by one of the leading London companies.

In phraseology and general arrangement there are marked differences between the present and the earlier specification referred to. The technical requirements follow on the same lines, but in some respects are not so binding in matters of detail, while the main requirements for satisfactory working are clearly described, and strongly insisted upon.

The machines are to be three-phase, with armature windings, star connected, and wound for 6,300 volts between adjacent conductors.

The alternators are to be placed end-on to the engines, and a large plate of sheet-glass is to be fixed between them so as to effectually prevent oil splashes from engine to alternator. The

highest permissible cyclic irregularity in the fly-wheel is 1/300, and it is specified that some approved electrical device, such as Leblanc's damping or amortisseur coils, be supplied to ensure perfect parallel running between the different machines.

The allowable temperature rise, measured thermometrically, is 70° F. after 24 hours' run at normal full load taken with a power factor of unity; the normal full load of the sets being 3,750 KW. when working on an inductive load with a power factor of ·87, or 4,250 KW. when working on a non-inductive load with a power factor of unity. The emergency lcad is 4,900 KW. for half an hour, or practically 15 per cent. above the normal full load.

The efficiency demanded at full load is 97 per cent., at half-load 96 per cent., and at quarter load 94 per cent., when the power factor is unity. On an inductive load with ·87 power factor it will be sufficient to obtain 97 per cent. at full load, 95 per cent. at half load, and 91 per cent. at quarter load. Although varying percentages of efficiency follow naturally upon varying power factors, this is the first time we recollect any allowance being made for this in a specification. The allowable fall in pressure between no load and full load at constant speed and excitation is 7½ per cent. when the power factor is 1, and 18 per cent. when the power factor is ·87; these figures being the mean percentage between the increase in volts when the whole load is thrown off and the decrease when the whole load is thrown on under the conditions specified.

The short circuit current, after a period of two minutes, shall not exceed four times the normal full load current.

The engine specification is of a character which may be complied with by high-class engine builders. Provision must be made for controlling the cut-off of the engines from the switchboard gallery, and every care exercised that the sets are designed to work economically over a wide range.

With 190 lbs. steam pressure, a vacuum of 27 in. and steam superheated to a temperature of 500° F., the steam consumption must not exceed 11 lbs. per I.H.P.-hour, or 18 lbs. per I.H.P.-hour working non-condensing. With an engine efficiency of 91 per cent. and an alternator of 97 per cent. efficiency at full load, this means 16·75 lbs. per KW.-hour working condensing, and 27·5 lbs. per KW.-hour when exhausting to atmosphere. Tenderers are invited to guarantee, if possible, better results than these.

Thirty-eight of the motor-generators are to consist of 150-KW. dynamos driven by high tension three-phase synchronous motors, the dynamos being wound for 400—450 volts for lighting or 500—550 volts for traction purposes. The combined efficiency must not be less than 84 per cent. at full load.

The remaining 10 machines are each to consist of two 50-KW. dynamos driven by a three-phase high tension induction motor. The dynamos are to be shunt wound only, and will be employed as balancers to the lighting circuit, and on emergency to excite the larger motor-generators and bring them up to synchronising point.

A part of the necessary switch gear for the motor-generators is included in the present contract, and it will need care to make sure that the apparatus included in the tendered price fulfils all the specified requirements.

The first engine-alternator is required in 12 months, the second in 15 months, and the motor-generators as soon as possible. Separate offers may be sent in for engines, alternators and motor-generators, or the whole of the work may be tendered for. If separate offers are sent in the penalty is £100 per week for *each* engine or alternator, in the latter case the stipulation only applies to the first engine and alternator as regards £100 per week, and is £50 per week for the second set.

The contract price may be varied by the Corporation, acting through their engineer, during the progress of the work, to the extent of 10 per cent. There is an unlimited arbitration clause, the appointment of an arbitrator in case of disputes being vested in the President of the Institution of Civil Engineers, the arbitrator so selected being a member of that Institution.

The contractor must agree to pay the standard current rates in the district in which the work is carried out, or render himself liable to the forfeiture of the difference and the possible cancellation of the contract. We hope that, in the case of a proposal being made to place this order with a foreign firm, it will be remembered that such a clause as this is only in a full sense applicable to places where British conditions of labour are in force. Due consideration should be given to this stipulation before work of this character is placed abroad, as it means a serious handicap to British manufacturers to have to meet such requirements to satisfy public opinion, while foreign manufacturers are necessarily exempt from its operation.

THE B.A. SMALL SCREW GAUGE REPORT.

Report of the Committee, consisting of Sir W. H. Preece (*chairman*), Lord Kelvin, Sir F. J. Bramwell, Sir H. Trueman Wood, Major-General Webber, Colonel Watkin, Lieut.-Colonel Crompton, A. Stroh, A. Le Neve Foster, C. J. Hewitt, G. K. B. Elphinstone, E. Rigg, C. V. Boys, J. Marshall Gorham, O. P. Clements, W. Taylor, Dr. R. T. Glazebrook, *and* W. A. Price (*secretary*), *appointed to consider means by which Practical Effect can be given to the introduction of the Screw Gauge proposed by the Association in* 1884.

The Committee report that the present condition of the matter submitted to them is as follows:—

In the report presented at the meeting of the Association which was held at Bradford in 1900, it was recommended that the shape of the thread of the British Association screw gauge for the use of instrument makers should be altered in the following particulars for all screws from No. 0 to No. 11 inclusive.

For Screws.—That the designating numbers, pitches, outside diameters, and the common angle of 47½° remain unchanged; but that the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch, the diameter of the solid core being in consequence diminished by one-fifth of the pitch.

For Nuts.—That the designating numbers, the pitches, the diameters of the clear holes, and the common angle of 47½° remain unchanged; but that the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch.

The effect of these alterations is as follows:—

The threads of the screws and taps are of a very simple form, being cut with a single point tool or grinding wheel, with straight sides and a flat top, and the top of the thread is part of a cylinder. Though the form of the bottom of the thread depends on the correct grinding of the end of the tool, great accuracy is unimportant, as the screws and nuts do not come into contact there.

The theads of the nuts and ring gauges will be accurate in proportion as are the taps used to cut them, the edge of the thread forming the through hole being part of a cylinder.

The actual differences between the screws and nuts of the old form and that recommended are so small, that it is believed the old stocks will in practice be interchangeable with the new screws, so that the amount of inconvenience caused by the change will be exceedingly small.

The British Association screw gauge has been in use in England for 17 years. Many firms in England have originated the threads and constructed gauges for sale or for their own use, but the difficulty of producing them is great, and the market obtainable may have been insufficient to induce them to perfect the processes necessary for making them accurately interchangeable. In short, the British Association screw gauge of 1884 was of too complicated a form to allow of its accurate realisation except at a cost which has proved prohibitive.

That very accurate gauges with rounded threads can be produced is not disputed, but the difficulty of doing so for small screws is very great. The names of three firms in America and of one in Germany have been proposed to the Committee as being competent, and probably willing, to undertake the production of gauges and tools of the rounded thread., The Birmingham Small Arms Company, who produce interchangeable work on a very large scale, and to a high degree of perfection, use only round-topped screws, fitting all over, for bicycle work; and Mr. Clements exhibited gauges used by that firm illustrating his paper read before the section at Bradford. This firm does not produce these gauges for sale. The American firm of Pratt & Whitney have manufactured a large number of sets of gauges and screwing tools for the English Government, but declined to submit these to the Committee on the ground that they were not sufficiently accurate to satisfy us. After long delay they submitted to us three specimens, which were reported upon by this Committee at the Dover meeting. Though the best we had seen, they were distinctly inferior to the screws used in the ordinary micrometers purchasable in tool shops, which have threads of the character which this Committee has recommended for adoption.

While the round thread is only produced satisfactorily by a very few firms, who have made a special study of this class of work, the Committee believe that the form of thread they have proposed can be made in any fairly equipped tool room, and that this facility in producing or obtaining the necessary appliances must very greatly encourage the maintenance of an accurate standard in small screws, to promote which has been the object in the view of the Committee. If, on the other hand, these tools and gauges are very special, and perhaps costly appliances, obtained only by the refined processes of certain factories, their use in workshops will extend slowly. The Committee aim at putting the matter on such a footing that the common everyday appliances in the hands of workmen shall be of a good order of accuracy, and this is only possible if they are produced easily and cheaply.

It is not suggested by the Committee that the form of thread recommended is the best for all purposes and for all sizes of screws, and they have expressly excluded sizes of screws below No. 11 British Association gauge, which are produced by pressure and not by cutting. Their recommendation applies only to the screws used in instrument making and similar trades for assembling parts, of which screws a large proportion, perhaps 95 per cent., are of brass. Considerations affecting the use of screws for other purposes have been put before the Committee, especially by Mr. Clements, in the case of bicycle and gun screws, and by Mr. Taylor in the case of lens screws. These have thrown suggestive light on the question before the Committee, and will be closely considered by them if reappointed.

Since the last report the Committee's proposals have attracted much attention, but no sets of gauges or tools of the new thread have been submitted to them, and so far their recommendation has had no practical result. They are informed, however, that one firm of manufacturers in England are occupied in producing tools and gauges for their own use, and if they succeed in producing them of satisfactory accuracy, will submit them to the Committee.

Mr. O. P. Clements, the author of a paper on screw-threads used in bicycles, read before the Section at Bradford, has been elected to the Committee.

Mr. W. Taylor, who has taken a leading part in the standardisation of the screws of photographic lenses, and has been in communication with the Committee, has also been elected a member.

Dr. R. T. Glazebrook has been elected a member of the Committee.

Correspondence has passed between the Committee and Dr. R. T. Glazebrook, the director of the National Physical Laboratory, respecting the examination of screw gauges, and the following arrangements have been made:—

The National Physical Laboratory will undertake to examine and to report upon gauges of the British Association submitted to them.

The Committee have applied the grant of £45 made to them at Bradford to the purchase of apparatus for the examination of gauges by the National Physical Laboratory, and have appointed Mr. C. V. Boys, Lieut.-Colonel Crompton, Dr. R. T. Glazebrook, Mr. W. A. Price, and Colonel Watkin to be a sub-Committee for the expenditure of the grant. The Committee are of opinion that the previous grant of £45, made in 1900, will be insufficient to purchase the necessary apparatus, and recommend their reappointment, with a grant of £45.

THE SHOREDITCH ELECTRICITY ACCOUNTS.

In our leaderette pages to-day brief reference is made to the accounts of the combined lighting and destructor undertaking for the last year. It appears that out of the loans amounting to £248,818 sanctioned since the commencement of the undertaking, the sum of £206,913 has been borrowed, and £196,911 expended down to the end of the last financial year. The revenue account may be summarised in the following manner as compared with the results in the previous year:—

Generation of Electricity.	Expenditure 1900-1901.	1899-1900.
Coal and delivery on works	£10,996	£5,487
Other fuel (Refuse £6,408 less £3,613) ...	2,795	2,207
Oil, waste, stores and water	385	669
Wages at generating stations	2,091	1,687
Repairs and maintenance	3,250	2,018
Distribution of Electricity.		
Wages of linesmen, fitters and labourers	871	559
Repairs and renewals of mains	175	301
" " " " transformers, meters, switches, &c., on consumers' premises	18	13
Maintenance of apparatus at distributing stations	479	75
Other expenses.		
Public lamps	£1,089	£716
Rents, rates, and taxes	626	398
Management expenses	1,839	1,300
Law and Parliamentary charges	169	—
Insurance	265	302
Wiring and fitting work	1,960	3,452
Other items	—	100
Total expenditure ...	£27,008	£19,284

	Income. 1900-1901.	1899-1900.
Sale of current	£21,750	£16,771
Public lighting	5,748	5,144
Maintenance and repairs of arc lamps ...	1,094	—
Rents receivable	27	75
Other items	50	46
Wiring and fitting	2,136	3,454
Sale of lamps and carbons, and discounts allowed	57	—
	£30,862	£25,490

It will be seen from the summary that by deducting the total expenditure of £27,008 from the revenue of £30,862, there remains a gross profit of £3,854, as compared with £6,206 in the previous financial year. An examination of the debit side of the net revenue account shows a total allocation of £8,948, made up as follows:— Interest on debt, £5,513; instalments of principal, £2,065; payment to reserve fund, £1,000; income-tax, £345; and £25 written off one account. The credit side discloses a balance of £1,600 from the last account, £3,854 as gross profit from the revenue account, £50 as interest on money at deposit, £53 transferred from the public lighting account, and £125 as the value of stores brought into account. These amounts make a total of £5,682, which, when set against the £8,948 on the debit side, shows a deficit of £3,266 for the year.

It has already been suggested that exceptional circumstances may have brought about the unsatisfactory working results for the past financial year. In the first place, the comparison given in the summary indicates that the cost of coal has been doubled as compared with the preceding year, although the number of units generated advanced from 2,135,191 to 2,982,364 units. Of course, the price of coal was much higher during the year than it is at present, and this largely accounts for the greater outlay on this item in conjunction with the larger number of units generated. It seems, however, rather curious that the cost of "other fuel," to which reference will subsequently be made, should also have risen in sympathy with the advance in the price of coal, and that, too, to the extent of £588 in the 12 months. Water shows a saving of £221, which is doubtless due to the yield from the artesian well; whereas repairs of engines and boilers, which only necessitated an expense of £194 in 1899, have now involved an outlay of no less than £2,478. The wiring and fitting department exhibits a heavy decline in the amount of work carried out, the figures being £1,960, as against £3,452, and there is no apparent explanation for this diminution unless the competition of local firms—one of which has strongly protested against this form of municipal trading—has anything to do with the matter. At any rate, the income from this branch disproves the statement that the work has been carried out at a loss seeing that a profit of £176 has been earned. On the other hand, there has been a considerable increase in the sale of current by meter, whilst the charge for public lighting has also been advanced and a large sum for repairs and maintenance of arc lamps appears on the credit side for the first time. The prices for supply were increased all round some months ago, but whether this will affect the consumption remains to be seen. If it does not the present year's working should exhibit more favourable results, especially as the coal contracts entered into recently are at much lower prices than those obtaining in the year under consideration.

It is satisfactory to find that on the present occasion there has been restored to the abstract of accounts what was omitted in the preceding year—namely, a revenue account relating to the refuse destructor. The account shows on the expenditure side, the payment of £3,420 for wages, and £270 for salaries; repairs and maintenance, £738; oil, waste, water, and engineer's stores, £180; cartage of clinker, £1,212; rates, taxes, and insurance, £532; establishment charges, £49; and experimental furnace, £7. On the other side of the account, the income from the destruction of refuse for the dusting and scavenging department is shown to be £2,464, and that from trade refuse, £187; sale of flue dust, £27; and supply of steam to the Hoxton baths and washhouses and free library, £935. These items make a total of £3,613, and the difference of £2,795 between this total income and the total expenditure of £6,408 has been charged to the electricity works revenue account, as shown in the summary, as the value of the refuse supplied as "other fuel" to that department. It is unfortunate that the account omits to mention the tonnage of refuse destroyed, or the charge per ton made to the scavenging department for this work; it probably ranges from between 20,000 tons to 25,000 tons, and should not exceed 2s. per ton for disposal. In conclusion, it may be mentioned that the units sold amounted to 2,257,009, and the number of public arc lamps in use to 257, whilst the total maximum supply demanded reached 1,340 KW., as compared with 1,050 KW. in the previous year.

THE STATUS OF ENGINEERS.

A propos of the status of engineers, to which we referred in the Electrical Review of August 10th, 1901, we note that in an article on the education of engineers in the pages of *Cassier's Magazine*, Mr. Randolph asks that engineers should be educated commercially, and writes as though this were the last thing that was thought of. While we deplore the want of opportunity afforded to young engineers to learn the commercial side of engineering, we must say that we have found them constantly striving to attain such knowledge.

The pupilage of an engineer rarely embraces this department. The proprietors of works will ask why should they put into the hands of their pupils a knowledge of such things as will enable the pupil to go into the world and compete with them? Now, assuming that these proprietors are carrying on a sound business, we think they make a mistake. Pupils who pay premiums especially, and others also, will go into business and will compete. If they understand pricing, their competition will be fair and reasonable; but if they do not understand it, they will probably cut prices, introduce a very keen competition, and do more harm to their old teachers than if they had been honestly taught their whole business. Nor do we think it would be altogether to the disadvantage of a firm that they should admit pupils to a full knowledge. Among the rising youngsters of to-day there are no doubt some who, did their employers but recognise their ability, might prove a veritable gold mine to them. Young blood is by no means to be despised. The lack of it in so many old-established works lies at the bottom of their decay. There is absolutely no reason why an old-established business should decay. It often does decay, simply because it goes on from father to son and grandson, and each one learns only from his predecessor, and learns old and obsolete ways. Pupils come and go, but never a one stops, for there is no encouragement, and so the business rots. We know lots of them doing good honest work, but at a hopeless cost.

Speaking generally, we should say that engineers of any experience are better men of business than business men are engineers. We have rarely found that an engineer, who is a sound engineer, has recommended a certain course of action without taking cognisance of the business side of the question, and we have known business men to become very abusive of engineers, because, as they said, the engineers would not consider money, where the true facts have been that the engineers have sought to expend capital that would return itself in four or five years, and the business men either did not understand the matter, or concealed the lack of ready capital. When an engineer is kept in ignorance of financial matters, it is his duty to recommend everything to be done in the way of improvement that will produce such an economy that, after providing the necessary sinking fund, there will be a surplus more

than sufficient to pay a good commercial interest. What this interest may be is obviously dependent upon the particular case. Where money is scarce and can be turned over to good advantage in the business, the economy to be secured by improvements will need to be relatively high, but where money is cheap or easily borrowed, improvements may be more readily faced.

In all cases they must afford a good prospect of being continuous in effect, as, for example, where steam plant is made condensing or where a private water supply takes the place of an extortionate London water company. We are confident that many economies are lost because the controlling voice is that of the non-engineer, who does not understand the facts, and dare not, or will not, accept the risk as it appears to him.

Perhaps where engineers have gone astray as far as in anything is in steam plant, which has been too much rated by its performance in indicated horse-power and not by brake horse-power. But even here the error of the engineer has been rather one of engineering. He has not been fully aware as an engineer of the large amount of internal loss in an engine, and has been carried away too much perhaps by the cry for having things large enough so that they will not fail. A steam engine that fails is, of course, likely to set up a far greater loss than it would do by being merely wasteful in fuel. Make things strong enough would often be sounder advice, for with steam engines one can usually make them turn their growing loads if they will only not fracture.

In manufacturing engineering the losses due to want of system are enormous. It is not difficult to turn out good work, but it is difficult to do so at a fair and reasonable cost in the absence of system, and the main intention of system should be to turn out work as nearly finished as possible from the machine with a minimum of hand work. But it costs money to adopt new systems, and it demands courage and intelligence to carry these things through. We believe that the general principles of business are fairly understood by engineers. They acquire many in course of their gradual progression through the shops, the drawing office, and subsequent positions that they may hold, but very few either of our engineers or business men seem to realise the importance of systematic manufacture. It is understood far better in America in its general bearing, but Americans have never been able to divorce themselves from their old practice, and continue still to design most things too light, and to sacrifice all durability to cheap production. The character of American products is now suffusing the world over as the result of the success of the business man over the engineer. The business man of America has drawn so tight the purse-strings that he has compelled the engineer to resort to all manner of artifice to design things that would look well, run well for a brief time, and, like the one-hoss shay, go to pieces within reasonable time of date of receipted invoice. In the so universal cry for cheapness, let our engineers understand how to make things as cheaply as possible, but we should regret to see our manufacturing engineers go beyond the cheapness that can be secured by method and system, for we are confident it will not pay in the long run. The Atbara bridge and the more recent one in India referred to by Mr. Randolph in the article above referred to, are both examples of a good system of getting work through, whilst already one of them has begun to demonstrate the vices of that overdone cheapness against which we have above entered our protest.

GAS ENGINE RESEARCH.

The second report of the Gas Engine Research Committee, by Prof. Burstall, was presented to the Institution of Mechanical Engineers at their meeting on October 18th.

Substantially no serious changes have been made in the plant, but a satisfactory ignition by electricity has been applied, consisting of a spark produced when a low potential circuit containing iron is broken. By means of a mica insulated plunger with the break well inside the cylinder this has now been secured, the plunger being actuated by the exhaust cam and an adjustable roller. The igniter has run two years without trouble. Four compressions have been used, viz., 55, 71, 93, and 124 lbs. The speed has been kept about 200 revolutions per minute, and the brake adjusted to give as close to the full power as possible with a minimum of missed explosions, in order that the air and gas ratios should not be disturbed. Air was measured through a wet meter, so that actual air ratios might be known. The least possible air volume can be calculated from the gas analysis; also the number of volumes of CO_2 produced and the final volume of products.

The calculations cannot well be briefly reproduced, but the reporter's conclusions may be. Thus, the highest mean calculated temperature of 2,000° C. is given by the reporter as probable. But he considers the core of gas in the cylinder may be even hotter than this. Now most authorities have set down the maximum limit as 1,600° C., a limit considered too low by the reporter. It is satisfactory to find that at last there is consideration given to the question of the increase of specific heat with temperature when finding changes in internal energy. The burning mixture consists of nitrogen, carbonic acid, oxygen, and water vapour. The author has adopted the values of specific heat as given by MM. Mallard and Le Chatelier.

These authorities have given the values at constant volume and temperature t—

$$CO_2 = 0{\cdot}1477 + 0{\cdot}000176\,t$$
$$H_2O = 0{\cdot}3211 + 0{\cdot}000219\,t$$
$$N = 0{\cdot}170 + 0{\cdot}0000872\,t$$
$$O = 0{\cdot}1488 + 0{\cdot}0000763\,t$$

These figures are from the only experiments available at gas engine temperatures. The value of the specific heat for different air ratios corresponding with a percentage of CO_2 varying from 9·32 to 4·59, is from ·1834 + ·000112 T to ·1745 + ·000099 T, the air to gas ratio being from 6·70 to 13·51.

There are useful and interesting tables of these and other figures. No English work on gas engines realises or recognises the variation of specific heat of gases at high temperatures. Indeed, the subject has been worse than neglected. It has been concealed behind an assumption of dissociation and delayed combustion that has been carried to an altogether unjustifiable limit; for have not the facts as to variation of specific heat been sufficiently known to have at least demanded attention? On this hypothesis the author finds that the heat is lost to the cylinder walls in almost all cases during expansion, and the apparent after-burning effects are really due to the decrease of specific heat as temperature falls by expansion and radiation. Adiabatic curves for both assumptions are shown on one indicator diagram. The experiments point to maximum economy being nearly adiabatic, and to after-burning being detrimental, as would be supposed. Very high compression is not advocated, and it is particularly noticed that gas engines only utilise about one-third of their total temperature range, as compared with steam engines that utilise three-fourths their range. The heat value of hydrogen is recommended to be taken on the basis of all steam being rejected as steam with its load of latent heat, and not on the usual calorimeter result.

The author hardly advises the use of the entropy diagram, owing to the labour involved being beyond the results secured. A special experiment was made to determine the heat lost to the jacket. This, of course, is made up of the heat shown in the water and the loss by radiation from the outer jacket surface. This outside radiation was quite considerable.

No trace of carbonic oxide could be detected in the exhaust, though as little as $\frac{1}{10}$ of 1 per cent. would have been detected if there had been any. This points to combustion being perfect.

One of the principal objects of research was the determination of temperature at all points of the Otto cycle by means of direct measurement. The method employed was that of the electrical resistance thermometer of Prof. H. L. Callender, F.R.S., by which temperatures can be measured with great precision.

The thermometer employed was a piece of solid drawn steel tube 1 in. diameter, 18 in. long, and $\frac{1}{20}$ in. thick. It contained four platinum wires passing through holes in a slate block closing one end of the tube, and passing out through a wooden block at the other end. The wires projected into the clearance space of the cylinder, and the temperatures near the wall of the cylinder showed as much as 200° C. below the central temperatures.

In the first position with the wire level with the cylinder wall the temperature was 977° C. at $\frac{3}{10}$ths of the stroke and 714° C. at $\frac{5}{10}$ths stroke.

In the second test, projecting $\frac{1}{2}$ in., the temperatures were 1,100° C. and 765° C.

The appendices contain tables of coal gas analysis and calorimetric values and of the results of the trial runs. Maximum temperatures up to 1,751° C. are shown, with exhaust temperatures of 1,097° C. down to as low as 737° C., and compression temperatures of 318° C., the trials numbering eight, with air ratios from about 6 to 12.

In a second series of trials a maximum temperature of 1,948° C. was secured, with ratios of air 5·4 to 10·5.

Four series of trials in all are fully tabulated, and the figures are full of interest, showing the variation of mechanical efficiency for different compressions.

The maximum compression gave the maximum I.H.P., with rather less mechanical efficiency than a compression of half the amount, but the gas per B.H.P. was considerably reduced.

The publication of these results should place the theory of the gas engine for the first time upon a sound basis, as it will serve to eliminate much of the cloudiness that has enveloped the gas engine. The specific heat variation now first recognised as pertaining to gas engine research should greatly assist to clear all future discussions on the question. It is unfortunate that it has not been found possible to employ the resistance thermometer on a fully working engine, all attempts to do so resulted in fusing of the wires before sufficient readings could be taken. Temperatures therefore had to be taken on an engine running light, or with about one-sixth of possible explosions. Further, the wire only follows the gas temperature through the expansion at speeds of about 120 revolutions per minute. The measuring wire is only 0·0025 in. to 0·0015 in. diameter. Generally very good agreement is found between results shown by the resistance method and those arrived at by calculation from the volumes and pressures.

By knowing the volume of air drawn into the cylinder, the temperature of the suction stroke can be calculated. Indeed, a full knowledge of all volumes admitted to the cylinder is important, and we believe this is the first time they have been actually measured. We regret we cannot publish the paper in full, and it would lose too much to suppress the tabular matter.

Llandore (South Wales).—Messrs. Handley & Shanks, of Birmingham, have secured the British Mannesmann Tube Company's contract in connection with their extensions at Llandore, South Wales, including Jandus arc lamps and incandescent lamps.

THE INTERNATIONAL ENGINEERING CONGRESS OF 1901.

MODERN COMMUTATING DYNAMO MACHINERY.

(Abstract of Paper read before Section IX. by H. M. Hobart, M.I.E.E.)

(*Continued from page* 650.)

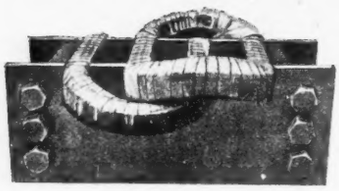
In connection with some investigations which Mr. Parshall and the writer are making in the subject of "Alternating Current Design," some tests were made for the purpose of determining the decrease in the inductance, accomplished by the sub-division of a given number of turns in many slots. Some of the results have considerable bearing upon this question of the reactance voltage in commutating dynamos.

Five sets of punchings were prepared with different numbers of slots corresponding to 1, 2, 3, 4, and 6 slots per pole-piece. The ratio of width to depth was the same for all five models.

The punchings were cut from annealed transformer iron about 0·38 mm. thick and built up to a depth of 63 mm. Each lamination was japanned on one side only, corresponding to some 10 per cent. of the total depth. The laminations were held together by end plates of manganese steel 6·4 mm. thick, bolted together by means of insulated brass bolts. The coils were wound on formers, taped up and forced into the slots. The wire used was No. 14 S.W.G. (2·04 mm. bare diameter) and 144 turns were wound on each set, the total turns being evenly distributed among the slots. Photographs of the five sets are shown in figs. 9, 10, 11, 12 and 13.

Fig. 9.

Fig. 11.



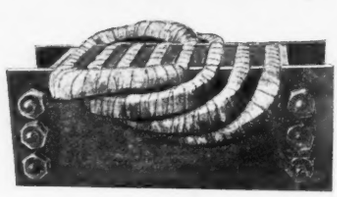


Fig. 10. Fig. 12. Fig. 13.

The data contained in Table XV. relate to these five models.

Table XV.

Size of slot in mm.	Number of slots.	Number of coils.	Turns per coil.	Total turns.	Measured resistance (ohms at 20° C.).	Corres. mean length of turns (cms).
36·8 × 24·2	2	1	144	144	·33	43
26·2 × 17·2	4	2	72	144	·31	41
21·4 × 14·0	6	3	48	144	·29	38
18·4 × 12·1	8	4	36	144	·31	41
15·0 × 9·9	12	6	24	144	·31	41

The magnetomotive force of the "free length" would not affect the results by more than some 10 to 23 per cent. at the most.

In the curves of fig. 14 are given the results obtained for these models when measured without any pole-pieces, which corresponds to the condition of minimum inductance. It is interesting to observe that, for the six-coil model, the reactance is still 45 per cent. of the uni-coil model, and these two models represent very extreme cases.

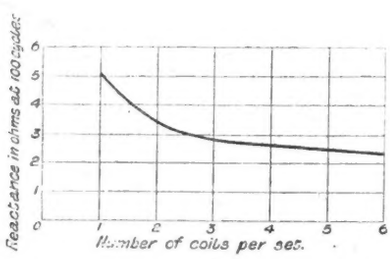


Fig. 14.

In fact, while the two cases sketched in fig. 15 represent diagrammatically the cases of models 1 and 5; the most extreme cases which would be met with in practice in continuous current dynamos—as relates to coils simultaneously commutated—would not vary from one another so much as the two depicted in fig. 16.

The writer has gone into this matter at length, because it has considerable bearing upon his contention that one is justified in taking a representative value as he has done, say four lines per ampere-turn per centimetre of embedded length, in instituting comparisons of the reactance voltage of various machines.

If one analyses the results of the curve of fig. 14, changing the values into C.G.S. lines per centimetre of embedded length and neglecting the free length, one obtains the results given in the curve of fig. 17.

For the purpose of studying the extent of the influence of the shape of the slot, the writer had built a series of models of the dimensions and with the windings shown in fig. 18. The inductance tests made upon these five models give the results set forth in Table XVI.

Table XVI.

Model.	Width of slot (millimetres).	Depth of slot (millimetres).	Width ÷ depth.	A. Observed inductance (henrys).	B. Inductance corrected to correspond to more normal wave form (henrys).	C. Lines per ampere-turn corresponding to column B.
I.	—	—	—	·000280	·000243	169
II.	20	15	1·33	·000365	·000317	220
III.	15	20	·75	·000400	·000347	242
IV.	10	43	·23	·000495	·000430	299
V.	5	60	·083	·000805	·000700	485

In fig. 19, the inductance of Model I., corresponding to the case of a smooth-core winding, is taken as 1·0, and the relative values for the other models are plotted in terms of the ratio of the width to the depth of the slot. From the curve it is seen that considerable changes in the slot proportions are necessary to even slightly affect the inductance of the winding. Furthermore, the shape of the slot would in actual machines, be even less influential.

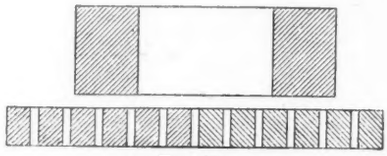


Fig. 15.

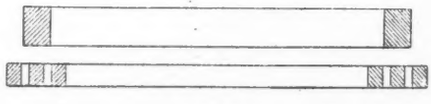


Fig. 16.

If for the models of fig. 18 we estimate the inductance of the "free length" at 0·8 lines per centimetre, then for the "embedded length," working from column C of Table XVI., the results set forth in Table XVII. are obtained for the inductance per centimetre of "embedded length."

TABLE XVII.

Model.	Lines per centimetre of "embedded length."
II.	2·8
III.	3·2
IV.	4·2
V.	7·5

It must not be forgotten, in considering these results, that very extreme cases were examined.

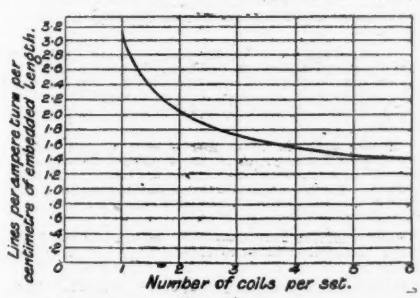


FIG. 17.

Some tests were made with a coil, of which the inductance was measured, first with the coil at the bottom of the slot, and then in positions successively higher and higher, until finally the coil was

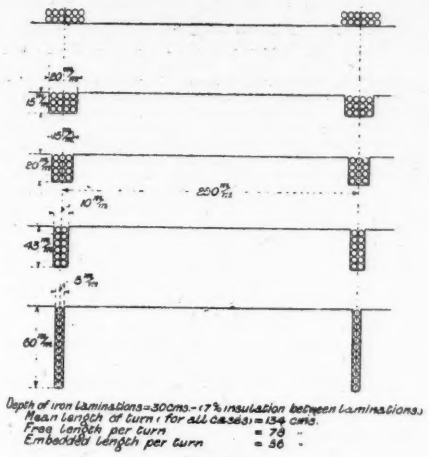

Depth of iron laminations=300ms.-(7% insulation between laminations)
Mean length of turn (for all cases)=134 cms.
Free length per turn = 78 "
Embedded length per turn = 56 "

FIG. 18.

entirely removed from the armature. The results are shown in the curve of fig. 20.

We may analyse this case as follows:—

Lines per ampere for "free length" .. .. = 170 × ·8 × 6 = 815
Lines per ampere for "embedded length" ... ... = 64 × 4 × 6 = 1,540

Total flux (C.G.S. lines) ... ... = 2,355
Estimated inductance 2,355 × 6 × 10^{-8} ... = ·00014 henrys.
Observed inductance with a coil 40 mm. × 10 mm. in one slot with abnormal wave-form supplied ... ... = ·00022 "
Corrected 15 per cent. for more normal wave-form ... ... = ·00019 "

Had the coil been rather spread out, say part in one slot and part in the adjoining slot—this representing a more average practical condition—this 36 per cent. excess of the corrected observed result over the estimated result, would have been decreased.

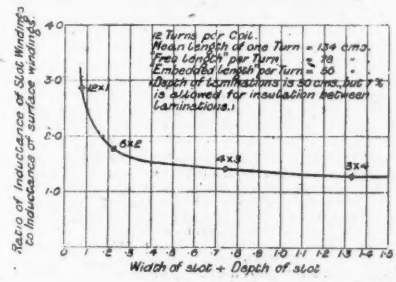

12 Turns per Coil.
Mean length of one Turn = 134 cms.
Free Length per Turn = 78 "
Embedded length per Turn = 56 "
(Depth of Laminations is 30 cms. but 7% is allowed for insulation between laminations.)
Ratio of Inductance of Slot Winding to Inductance of surface winding.
Width of slot ÷ Depth of slot

FIG. 19.

In the preceding test, the "embedded length" was only 27 per cent. of the mean length per turn. This tended to obscure the influence of the depth in the slot of the "embedded length." Another test was made upon a 5-turn coil of which the mean length of turn = 105 cms.; "free length" per turn = 56 cms.; "embedded length" per turn = 49 cms., the "embedded length" thus constituting the high proportion of 47 per cent. of the mean length per turn.

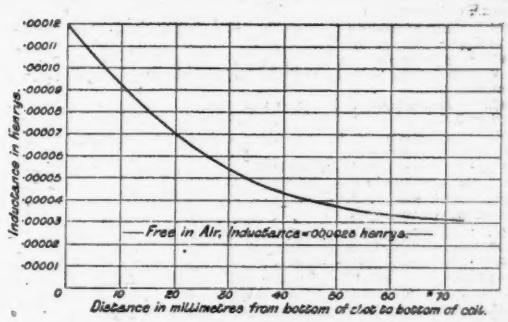

Inductance in henrys.
Free in Air. Inductance=·000025 henrys.
Distance in millimetres from bottom of slot to bottom of coil.

FIG. 20.

FIG. 21.

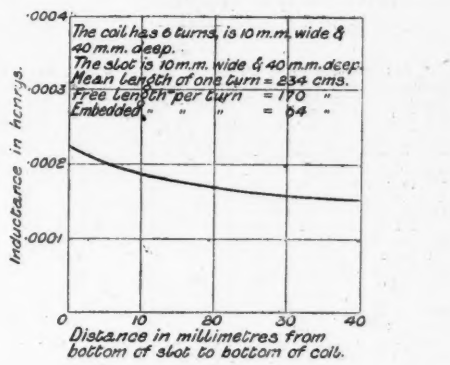

The coil has 6 turns, is 10 m.m. wide & 40 m.m. deep.
The slot is 10 m.m. wide & 40 m.m. deep.
Mean length of one turn = 234 cms.
Free length per turn = 170 "
Embedded " " " = 64 "
Inductance in henrys.
Distance in millimetres from bottom of slot to bottom of coil.

FIG. 22.

Measurements were made in four positions of the coil:—

1. Coil at the very bottom of the slots.
2. Top of coil just level with top of slot.
3. Bottom " " "
4. Coil free in air.

The coil was 20 mm. high × 10 mm. wide.
The slot was 41 mm. high × 10 mm. wide.
The three first positions are shown in fig. 21 and the results are given in the curve of fig. 22.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,932. "New or improved means of interconnection or disconnection between a number of circuits for the distribution of electric energy." W. J. HOWARD. October 7th.

19,939. "An alternative system of tubes with soldered connections for gas or electric cables." D. PURVES & Co. October 7th.

19,973. "Improvements in brushes for dynamos and the like." J. MATTHEWS and W. DAVIES. October 7th.

19,990. "Improvements in electric arc lamps." C. M. SHAFER and J. VOYE, sen. October 7th. (Complete.)

20,019. "Improvements in or relating to machines for the manufacture of electric fuses or explosive charge holders." H. TIRMANN and H. TIRMANN. October 7th. (Complete.)

20,089. "Improvements relating to printing telegraphs." E. Malcotti. October 8th.

20,093. "Automatic synchroniser for coupling alternating current electric machines." J. Pearson and J. F. Williamson. October 8th. (Complete.)

20,106. "Improvements in and relating to combination plough switches and wheel switches for electric tramways on the slot conduit system." W. A. Heindle. October 8th.

20,175. "Improvements in apparatus for transforming electric currents." R. C. T. Evans. October 9th.

20,193. "Improvements in the process of covering electric conductors or wires with insulating material and in apparatus therefor." G. E. Heyl-Dia. October 9th.

20,215. "Improvements in electrical cut-outs or fuses." H. W. Cox. October 10th.

20,243. "Improvements in electric measuring instruments." A. R. Hakoumoff. October 10th.

20,258. "Improvements in electrical measuring instruments." E. Reiniger and H. Lion. October 10th. (Complete.)

20,294. "Improvements in track construction of conduit electric railways." W. Chapman. October 10th.

20,364. "Improvements in plural fuse cut-outs for electric circuits." J. Felsenstein. October 11th. (Complete.)

20,384. "Variable pressure electric current transformer." C. J. Ritzer. October 11th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 11th, 1901, being date of application in United States.) (Complete.)

20,406. "Improvements in trolley heads for electrically-propelled vehicles." E. Y. Walsh and J. Leigh. October 12th.

20,455. "Improvements in electric signalling device for railways." R. Els. October 12th. (Complete.)

20,462. "Improvements in electro-magnetic clutches." H. A. Earle. October 12th.

20,473. "Improvements in the manufacture of insulated or covered wires, and in machines therefor, and for like purposes." C. Martin. October 12th.

20,476. "Improvements in or pertaining to electric incandescence lamps." W. J. Phelps. October 12th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

25,407. "Improvements in holders for electric incandescent lamps." J. P. Phibbs. Dated December 22nd, 1899. Relates to holders for incandescent lamps. A bayonet-capped lamp is held by the ordinary pins and slots, and by pressure of spring tongues, in a socket which slides longitudinally on a grooved insulating body to enable the lamp to be placed in or out of contact with two terminals fixed in the body. The socket has oblique projections or slots in engagement with corresponding parts of a cylindrical case, which is held between a shoulder and a split ring on the body, so that it can be turned thereon, to raise or lower the socket. The split ring is secured by a nut screwed on it. A spring in the case assists downward movement of the socket, to quicken the break of the contact. The insulating body may be in one piece, made with an axial hole to pass the conductors, a transverse opening to receive a supporting knot thereon, and a central partition to separate the contact pieces; or the upper part of the body may be of metal, with two extensions fitting in recesses in an insulating portion. The body may be screwed into a coupling nut on the end of a supporting bracket, this nut supporting the case also. The case may be made with a lining tube, in which the oblique slots are provided, the outside being provided with an ordinary shade-carrying shoulder, screw, and nut. 6 claims.

25,417. "Improvements in and relating to electro-magnets." L. J. Delayeau. Dated December 22nd, 1899. Relates to a sheathed electro-magnet, provided with a movable armature or core having a long play. The sheath or casing is made in one or more pieces, and has a circular opening at each end. Within it is supported the bobbin or reel wound with insulated wire. The armature or core consists of a hollow cylinder, or a solid shaft of soft iron, provided at one or both ends with a series of discs or washers, which may either be formed in one with the core, or attached thereto by means of a stud or screwed rod. The several discs or washers may be of varying shape in cross-section; they may also be made of varying diameter, and may be disposed at different distances apart. 3 claims.

25,421. "Improvements in alternating current generators." S. G. Lamme. Dated December 22nd, 1899. Relates to alternating current dynamos armatures:—To facilitate the insertion of the armature coils, the slots for receiving each group of coils are made parallel to each other instead of radial. In the case of wire-wound coils, the several coils constituting a group are separately wound and inserted into their respective slots, and are afterwards connected together. In the case of a strap winding, each coil for each group corresponding to a pole is bent or coiled into the required shape for insertion into the slots and suitably insulated. 1 claim.

25,422. "Improvements in systems of electrical distribution and circuit-breakers for use therein." L. B. Stillwell. Dated December 22nd, 1899. In systems of distribution in which the energy is transmitted to sub-stations and then distributed, cut-outs are employed which are controlled by a time mechanism so that the main circuits may not be opened should a short-circuit occur on one of the branches. In one form of circuit-breaker the main has in it the primary of a transformer. In circuit with the secondary is an electro-magnet and the electro-magnet of the circuit-breaker. The armature of the magnet is connected to a pawl acting as a stop to the time mechanism, which tends to drive an insulating disc fitted with a contact-strip. A brush rubs on this conducting strip, and so short-circuits the magnet of the circuit-breaker. Should an excessive current flow through the first magnet, the clock mechanism is freed, and after a predetermined time the insulating portion of the disc comes in contact with the brush and the magnet of the circuit-breaker is energised. Circuit-breakers having different time elements are fitted in different parts of the system. 8 claims.

25,439. "A new or improved electrical apparatus for automatic signalling." E. Cadot, Peronne, and C. Chevallier. Dated December 22nd, 1899. Relates to an electric contact maker applicable for automatic signalling in connection with targets, for indicating the opening of doors, carriage gates, &c., and for other similar purposes. 8 claims.

25,446. "Improvements in and connected with electric railway motors." British Thomson-Houston Company. (E. D. Priest.) Dated December 22nd, 1899. Relates to electric railway motors and to the manner of mounting them on the motor vehicle. The motors are each mounted on a separate axle, and the axle and its motor form a single structure, which is free to move in its support independently of the truck frame. 15 claims.

25,448. "Improvements in the controllers of electric motors." British Thomson-Houston Company. (F. E. Case.) Dated December 22nd, 1899. Relates to safety devices connected with the controllers of electric motors for railway and other vehicles. Should the attendant's hand leave, even momentarily, a button, a spring lever is drawn out of a slot in a sleeve which is then rotated by a spring, and a pin on a cam attached to the sleeve engages a pawl, which releases an arm allowing the spring to draw the bridge from the contacts. The device is reset by turning the controller, and this causes the projection to engage the toe, and the pin clears the pawl, which then engages the arm. An excessive current passing through the series coil attracts its armature and pawl and releases the arm. 8 claims.

25,449. "Improvements in means for controlling electric motors." British Thomson-Houston Company. (A. G. Davis and W. B. Potter.) Dated December 22nd, 1899. In starting and regulating electric motors, a source of counter-electromotive force is substituted for the whole or greater part of the resistance usually employed. This device may consist of another electric motor, preferably connected with an air compressor in order to store the mechanical energy produced by it. 12 claims.

25,450. "Improvements in systems of electric train control." British Thomson-Houston Company. (W. P. Potter.) Dated December 22nd, 1899. Relates to systems of electric train control from a single point direct or alternating currents of single or polyphase type being used. 13 claims.

25,451. "Improvements in electric switches." British Thomson-Houston Company. (E. Oxley). Dated December 22nd, 1899. Arcing is prevented by breaking the circuit at the surface of a liquid conductor or electrolyte having considerable resistance. 9 claims.

25,452. "Improvements in means for cooling electric and other brakes." British Thomson-Houston Company. A. Ekestrom. Dated December 22nd, 1899. Relates to means for cooling brakes, particularly electric brakes, on railway vehicles. Cooling fluid such as air, oil or water supplied from a pump or reservoir is led by pipes along the train and circulated through the shoes when required. 7 claims.

25,453. "Improvements in alternating electric current motor systems." British Thomson-Houston Company. (A. G. Davis.) Dated December 22nd, 1899. Relates to alternating current motor systems, particularly those of the tandem and tandem-multiple types, the object being to enable the motors to be started with full torque and to run efficiently at various speeds when supplied from a source of single-phase currents. 20 claims.

25,464. "Improvements in electric alarms." M. Wessher and P. Wollenhaupt. Dated December 23rd, 1899. Relates to electric time-alarms for use in hotels, &c. 5 claims.

25,491. "Improvements in accumulator batteries." P. Marino. Dated December 23rd, 1899. The positive plates consist of a thin plate of lead coated with lead oxide and provided on each side with frames of ebonite or the like. The negative plates are of similar construction, but aluminium or other metal may be used instead of lead, and the plates are coated with spongy lead. The positive and negative plates are arranged alternately in a horizontal manner and separated by flat pieces of peat or lignite, which have been washed, dried, and successively treated in baths containing, firstly, water strongly acidulated with sulphuric acid; and secondly, alcohol or benzine. The plates thus arranged are tied together in bundles. All the plates and partitions have holes in them which become coincident when the plates, &c., are placed together, and in these holes are placed vertical tubes, having opening through their walls. These tubes facilitate the circulation of the electrolyte and the escape of gases. 1 claim.

25,509. "Improvements in methods or means of insulating electric wires." B. G. Hodges, H. Smith and W. A. A. Burrows. Dated December 23rd, 1899. Conductors or fuses are held together by means of interlacing threads embracing two or more insulated wires. 1 claim.

25,576. "Improvements in resistance switches and automatic cut-outs for starting, regulating and protecting electric motors and their circuits." Veritys, Limited, and L. J. Steele. Dated December 27th, 1899. Relates to starting and regulating switch for motors, fitted with a magnetic releasing arrangement so as to cut-out the motor in case of overload or failure of the current. 5 claims.

25,591. "Improvements in apparatus for wireless telegraphy." E. Guarini. Dated December 27th, 1899. (Dated applied for under Sec. 103 of Patents, &c., Act, 1883, May 27th.) The apparatus for a system of wireless telegraphy is arranged at any station so that such station can do any of the following: receive, transmit, transmit and register, repeat or translate, repeat and register. The sensitive portions are shown enclosed in a metal case provided with perforations to allow of exterior connections. The aerial conductor is connected through the armature of an electro-magnet to the coherer. The magnet is in parallel with the primary of the induction coil, so as to cut the coherer at the moment of translation or transmission. The coherer local circuit includes an indicating galvanometer and a relay. The receiver and transmitting key are arranged outside the box, and are provided with a plug switch by which the local circuits can be changed to suit the operation to be performed. 13 claims.

25,621. "Improvements in electric light switches." A. P. Lundberg and G. C. Lundberg. Dated December 28th, 1899. Relates to two-way and like switches particularly adapted for electric lighting controlled from two points, such as in staircase, &c., lighting. 3 claims.

25,622. "Improved method of fitting the covers of electric light fittings to their base parts." A. P. Lundberg and G. C. Lundberg. Dated December 28th, 1899. Relates to means for fixing the covers of switches, couplings, &c., to their bases. 4 claims.

25,628. "Improvements in electric fishing apparatus." I. W. J. Lindbohm. Dated December 28th, 1899. Relates to a rod fitted with an induction coil by means of which a current can be sent through a hooked fish to stun it. 1 claim.

25,641. "Improvements in electro-mechanical accumulators." H. W. Schlomann and A. de Castro. Dated December 28th, 1899. Relates to apparatus for accumulating or storing up energy by the relatively prolonged operation of a comparatively small motor or source of power, preparatory to the utilisation of the stored energy for a brief period in a motor of greater power to perform work which the smaller motor is incapable of performing directly, *e.g.*, starting vehicles, torpedoes, and rolling machinery. 7 claims.

25,681. "Improvements in and connected with electro-dynamometers." V. I. Feeny. (Allgemeine Electricitats Gesellschaft.) Dated December 29th, 1899. An electro-dynamometer for use with alternating current consists of coils fixed in a space within a horizontally-laminated iron block and enclosing a movable coil carried by a vertical axle, which also carries a pointer and a metal plate within the fields of permanent magnets to damp its movements. The outer portions of the magnetic circuit of the fixed coils thus lie in the iron block, and do not affect the permanent magnets. 1 claim.

25,701. "An improved controlling apparatus for electric motors." J. A. Steven and W. R. Haigh. Dated December 30th, 1899. Relates to apparatus for starting and stopping a motor gradually, resistances being cut out or into the circuit automatically. In starting the lever is caused to make contact with the first of the resistances of the rheostat, the motor then starting rotates the governor moving the sliding fulcrum of a lever so that the resistances are cut out as the speed of the motor increases. To stop the motor the lever is set on the last resistance, and in slowing up the resistances are cut in until the circuit is finally broken. 1 claim.

25,721. "Improvements in plates for storage batteries." A. Pallavicini. Dated December 30th, 1899. A support for the active material consists of a grid which is cast in one with side pieces, which are afterwards bent over so as to hold the active material in place. A number of projecting fingers or ribs crossing each other are also cast in one with the grid. 2 claims.

25,740. "Improvements in current collectors for electrical machines." S. G. Lamme. Dated December 29th, 1899. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, June 5th.) Collecting rings applicable to alternators, motors, or rotary transformers, are constructed to avoid heating of their insulation. Each ring is a rim carried by spokes on a hub, which may itself consist of two concentric parts connected by short spokes. The hubs are clamped between a collar and a nut on a metal sleeve with intervening insulating rings and sleeve. Connections are made with the rings by rods screwed into the hubs, and insulated from other hubs through which they pass. 8 claims.

25,746. "Improvements in alternating current electric motors." British Thomson-Houston Company. (C. P. Steinmetz.) Dated December 30th, 1899. Energy meters of any kind used for alternating currents are arranged so that they indicate or register definite proportions of the wattless current supplied in addition to the actual power or work done if the current is lagging, but in reduction thereof, if the current is leading. 15 claims.